MECHANICAL ENGINEERING

· AUGUST 1948 ·

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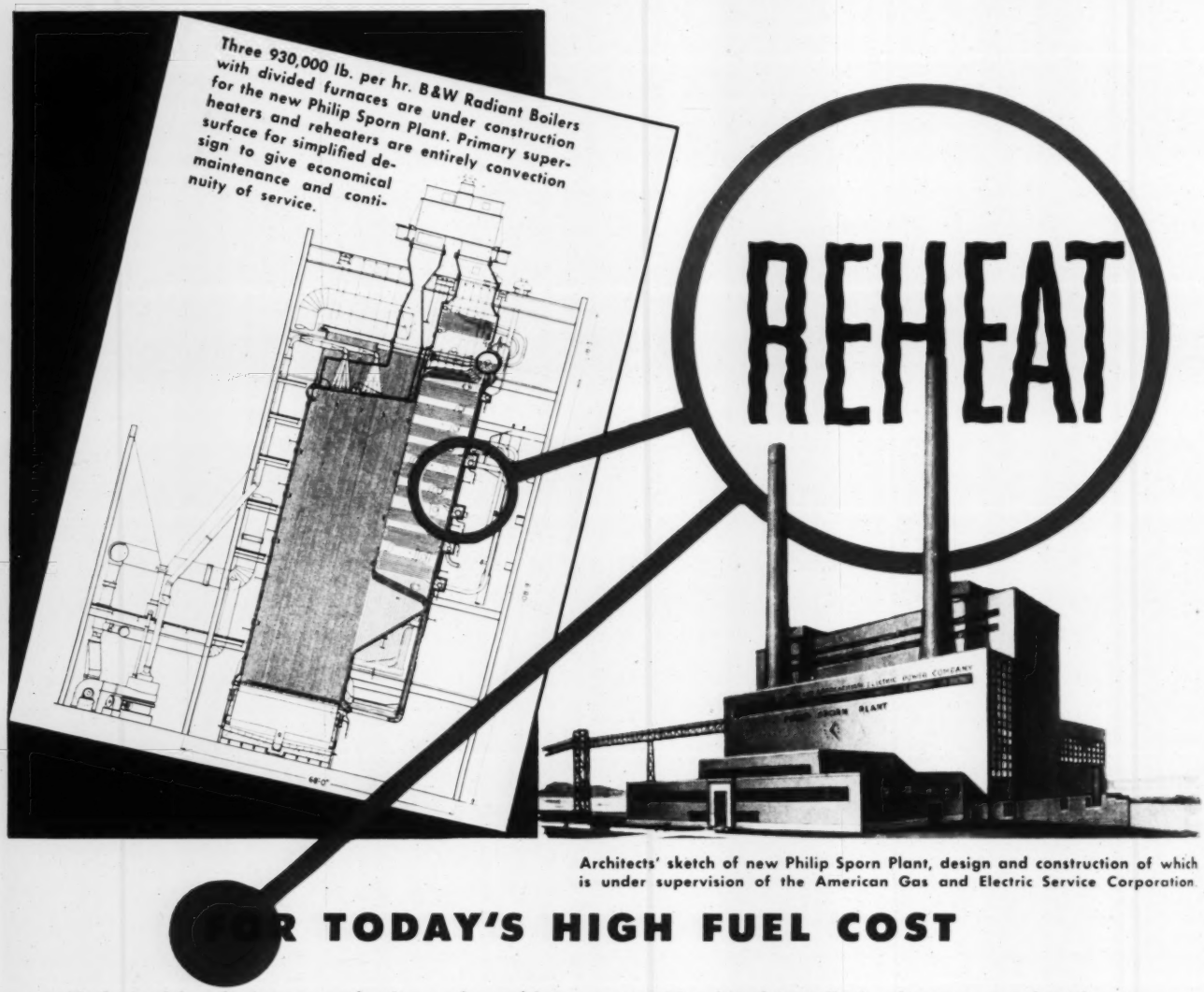
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MECHANICAL ENGINEERING

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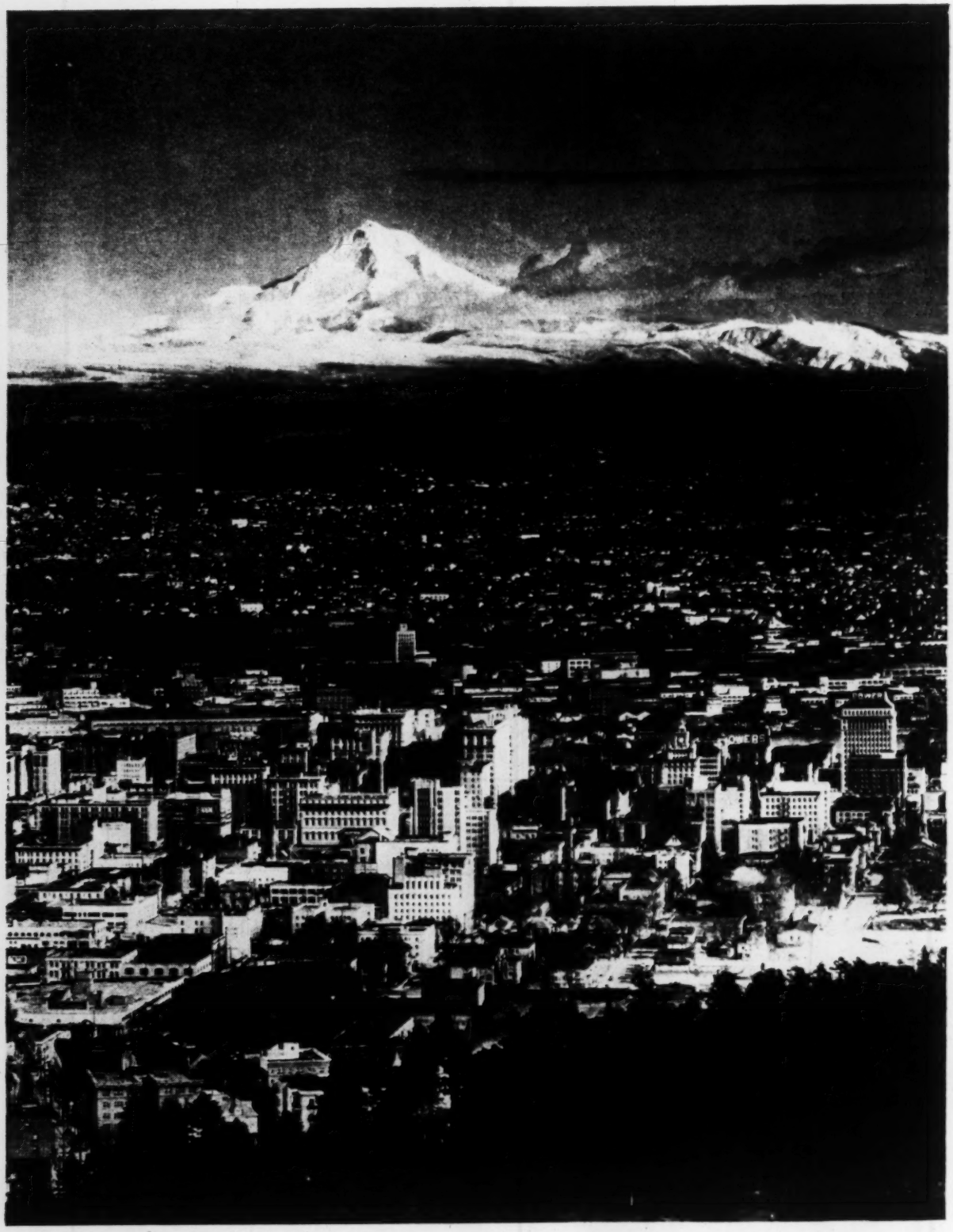

Portland, Ore., With Mt. Hood in Background

(*ASME Fall Meeting Program, Portland, Ore., Sept. 7–9, 1948, on page 705 of this issue*).

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MECHANICAL ENGINEERING

AUGUST
1948

GEORGE A. STETSON, *Editor*

Physics Today

THE appearance in May of the first issue of a new scientific monthly magazine, *Physics Today*, affords an opportunity to congratulate and encourage its sponsors, to direct attention of engineers to what should be to many of them a stimulating point of contact with the activities of physicists, and to review some of the problems that confront scientists and engineers in their societies and publications.

Physics Today is a "general-interest journal on physics," published by the American Institute of Physics. It goes to "all Members, Associate Members, and Associates of the Institute at no increase in the dues now in effect." Its editor, David A. Katcher, writes in the first issue: "*Physics Today* is for the physicist, to inform him in comfortable, everyday language, of what goes on and why and who goes where. But it is also for the chemist, the biologist, and the engineer, to tell them of the science toward which they are driven by so many of their investigations; it is for the student, the teacher, the lawyer, the doctor, and all who are curious about physics; it is for administrative officials who deal with research; it is for editors and writers whose position puts them midway between what is done and how it should be reported; it is for you, whatever reason brought you to this page."

Examination of the May and June issues—all that are available at the present writing—shows an attractive format, with dignified but not stodgy typography and make-up. Each issue contains about 32 pages of text material plus advertising. It is not an archivist type of journal but a readable general-interest magazine. The reader will find no mathematics and no five-dollar words that are not common to the vocabularies of educated persons. About a third of the text pages are devoted to signed articles and the remainder to "departments" which have broad appeal and yet perform the necessary "house-organ" function essential to society publications.

In assembling material for departments the editor apparently does not feel obligated to beat the bushes for something to make up a page or a column for each of them every month, but chooses the wiser course of omission when items of genuine reader interest do not press for attention. Departments include editorials, Institute Doings, Washington Letter, Notes From Abroad, Journal Notes (abstracts of articles in other AIP magazines), News and Views (relating to the field of physics), Books (reviews), Whereabouts (personals), Calendar of Events (meetings of scientific and engineering societies), and Contributors.

If the first issues are typical of those that are to follow, the reader may expect to find nothing beyond his field of interest or capacity to understand. To date no article has exceeded 3600 words and the average is nearer 2000, which in itself is an editorial achievement worthy of comment. A list of articles so far published will serve to show the tone and scope of what the reader may expect: "Trends in American Science," by Vannevar Bush; "Color Vision," by David L. MacAdam; "A Newsman Looks at Physicists," by Stephen White, science writer for the New York *Herald-Tribune*, "Physics and Cancer," by Arthur K. Solomon; "The Challenge of Industrial Physics," by Howard A. Robinson; "Pocono Conference," by Richard P. Feynman (a readable and informative commentary on a four-day conference on experimental physics arranged by the National Academy of Sciences, adorned with two delightful pen-and-ink sketches), and "Detecting Atomic Particles," by Serge A. Korff. Included also is a summary of the Annual Reports of the American Institute of Physics for 1947, an excellent example of how what is usually a formal and dreary document can be made interesting and intelligible.

Resisting the impulse to quote from the liberally penciled copies under review, let us pass on to a sketchy consideration of some of the publication problems confronting scientific and engineering societies. The launching of a new general-interest science magazine in an era of inflation which affects adversely publication costs and the real incomes of persons who need such a medium is in itself an act of faith and courage in support of which, it is hoped, a generous response will be forthcoming from readers, advertisers, and industry. Certainly there are few engineering societies, and probably few scientific societies, that are not today wrestling with publication problems. Many approaches toward satisfactory solutions are being proposed and attempted. Breaking with tradition raises doubts as to the efficacy of proposals and a certain amount of protest. Even when a better service is provided, interference with reading habits may generate an initial resistance to change.

Outside the area of cost itself, one of the major problems arises from the rapidly growing volume of literature that confronts scientists and engineers. One effect of this volume is the formation of specialist societies and specialist publications of the archive type. Even if a man had the means to join all societies related to his field and to subscribe to all the publications that might be helpful to him he would still lack the time to benefit largely from membership or to read all the articles of value to him. Hence membership in specialist societies is generally limited to specialists and the archive journals appeal to small groups and to special and a relatively

few all-inclusive large libraries. But as the number of specialist societies and publications grows, the fragmentation of areas of scientific and technologic knowledge and progress increases, as does the isolation of the individual specialist in respect to the broader fields of science and engineering, to new techniques of investigation and analysis, to the significance of results obtained, and to public understanding of the work and function of the specialist. There develops, therefore, the need for other types of societies and publications, as well as individuals, whose function it is not only to aid in the progress of the specialties, but also to communicate that progress to workers in other fields and to the public. The American Institute of Physics is an example of an organization of scientific societies in the field of physics in which the strength and the effectiveness of the whole is greater than the sum of its parts, that publishes journals of the archive type for the benefit of the specialists in its membership, that publishes also review journals in the broad fields of physics and scientific instruments, and that now ventures, with *Physics Today*, into a general-interest area attractive not only to its own members but to nonphysicists as well. Important as intensive cultivation of specialist fields may be, cross-fertilization, brought about by knowing what others are doing and the techniques by which they achieve results, add vigor and variety to the strain and increases the yield.

Multiplication of research units and of scientific and engineering societies and publications offers an almost irresistible impulse on the part of social and economic planners to bring a sense of order, purpose, and direction out of what appears to be unorganized and overlapping activities. Attention is focused on this problem in an article reporting, in *The Economist* of July 3, the Royal Society's Conference on Scientific Information and directing attention to the proposal advanced by the Association of Scientific Workers to provide "in effect for a form of nationalization of the machinery of scientific publication." The threats to virility and independence of thought and to democracy itself inherent in this proposal will be apparent to anyone, and if they are not, a reading of the article will reveal them. Well-intentioned zeal is no substitute for common-sense when it comes to safeguarding the independence of individuals and institutions. No amount of efficiency which might be gained by an all-inclusive plan, which must inevitably succumb to bureaucratic control, will ever compensate for restrictions on incentive, initiative, or independence.

It must be realized that nationalization is not the only means by which incentive, initiative, and independence of scientists and engineers may be restricted. The fragmentation of the fields of science and engineering which takes place in the formation of specialist societies and publications, the overlapping of efforts and programs, the apparent lack of planning and organization and of unity of purpose and action of professional people cause real and grave concern, but even a nongovernmental organization of the all-inclusive "super" type might develop abuses of power and restrictions on the incentives, initiative, and independence of the individual or suffer from the frustrations to which coalitions are vulnerable. The transition from aggressive and defensive solidarity to stupid and unyielding solidity is easy to make.

In general the scientific and engineering societies of this country are made up of specialists. The smaller societies, which are likely to be the result of a fragmentation process, are made up of one or a few groups of persons having a common concentration of interest. The larger societies contain more of these groups. The cohesive forces which act on all and upon the component groups of the larger societies are their overlapping technical interests—the interdependence of one group of specialists on others—and certain ideals, purposes, and functions which all their members share as professional people. The essential objective of their programs and publications must be to advance the field of knowledge in which they are engaged. They must maintain publications of the archive type. But as the diversity of the interests of their members grows and their membership increases, they must support general-interest publications for the broadening of their members and for the cross-fertilization of ideas from one field of endeavor to another. Roughly, but not too strictly, the Transactions and *Journal of Applied Mechanics* are the archive journals of The American Society of Mechanical Engineers, while MECHANICAL ENGINEERING is the general-interest publication devoted to cross-fertilization. Recent changes in ASME publication procedure have tended to enhance the value of each of these types of publication in so far as its primary function is concerned. Converting Transactions and the *Journal of Applied Mechanics* to a subscription basis has materially cut the cost of these publications to the Society, if not to an individual member. Digests of ASME National Meeting papers in MECHANICAL ENGINEERING have added greatly to the variety of subject matter brought to the attention of every member at only a fraction of the cost involved in supplying the complete text of papers not directly in his field and hence not likely to be read even for their general-interest value. A wealth of material not of ASME origin but in those overlapping fields is condensed in the "Briefing the Record" section. The pattern is clear, even if the product is not as perfect as it may become. The appearance of *Physics Today* encourages conviction that the pattern is good and is a stimulant to renewed endeavors to perfect the product.

SINCE our last issue the deaths of three distinguished ASME Fellows have been reported: Roy V. Wright, Lawford H. Fry, and Wallace Clark. Roy Wright, an Honorary Member and President in 1931, visited every ASME Section and a majority of the student branches during his term of office. His life was devoted to railways and to publications for that industry. He is known to recent readers for his pioneering work on the ASME Engineers Civic Responsibility Committee. Lawford Fry, also active in railway circles, received the Worcester Reed Warner Medal in 1938 "for contributions relating to improved locomotive boiler design and utilization of better materials in railway equipment." Wallace Clark, consulting management engineer, enjoyed an international reputation, and between two world wars aided in the modernization of government and private enterprises in Europe.

ENGINEERING *and the* MEDICAL SCIENCES

By LUIS DE FLOREZ

DE FLOREZ ENGINEERING CO., INC. MEMBER ASME

THE extraordinary development of science in modern times has placed an unprecedented responsibility upon man to exercise his newly acquired powers with wisdom and justice. We who live and work today in the field of science must assume an even greater share of this responsibility since we strive directly for the advancement of science itself.

Although the problems which confront our civilization are, for the most part, born of scientific development, we cannot hope to solve them by any effort to retard progress. Only one possible course of action lies before us—to forge ahead even more rapidly in the hope that greater knowledge will bring with it a clearer picture of our destiny and greater wisdom through better understanding.

The past century has witnessed scientific accomplishments which Aladdin and his lamp could not have produced for sheer lack of wishes. We have seen the harnessing of natural forces, the advent of electrical and chemical power, the development of communications and transportation, the conquest of the air, atomic fission; we have witnessed the development of thought and understanding typified by the evolution of the tinker into the mechanical engineer, the alchemist into the chemist, the leech and medicine man into our modern physician who can work routine miracles.

All these achievements have been brought about by individual progress in fields of science which at times seemed far apart, even unrelated, but as time went on and the level of knowledge rose, we began to realize the interdependency of all scientific work and the necessity for general advance in knowledge to make possible the reduction to practice of individual discoveries in specialized fields. Today the picture is clear. We cannot hope to progress through our own work alone, but must depend on the work of our contemporaries to provide us with new components and new materials. How could we build the aircraft of today with the metallurgy of yesterday? How could we navigate it without the development of electronics which give purpose to its present-day performance? How will we operate the aircraft of the future without advances in medicine which will tell us more of the capabilities and limitations of the human frame and mind? That I am able to stand before you tonight, on two feet, is not only due to the time-honored skill of the man who sewed one of them back on, but to those who developed penicillin and the industry that provides it for routine use; that combined magic which made it possible to enclose a dangling foot in a plaster cast, safeguard it against infection, and give it a chance to grow back on.

Indeed, the advance in our world of science which has been wrought in sections by countless individual efforts in many fields, benefits mankind more from the rising tide of its accomplishments than from the wavelike surge of a single discovery.

It is such thoughts that prompt me as an engineer to add what I can to the destruction of the already crumbling barriers separating the various fields of scientific endeavor by suggesting a much closer relationship between our work in engineering and yours in medicine that we may accelerate progress and hasten together toward our common goal of greater knowledge and greater wisdom.

An address before the Tufts Medical Alumni Association, April 7, 1948.

MEDICINE AND ENGINEERING TWO APPLIED SCIENCES

Medicine and engineering are the two great applied sciences Philosophically, they are the same. Each draws upon the knowledge won by research in the fundamental sciences and applies it to objective needs. Engineering draws mostly from physics and chemistry, whereas medicine draws mostly from biology. The method, however, is the same.

We realize that there is a fundamental difference between the branches of science concerned with inert matter and those concerned with living organisms. Our basic laws of physics and those underlying our engineering calculations have been derived through consideration of probabilities and chance, whereas there seems to be adequate evidence that when dealing with living organisms laws stem from a different pattern.

Nevertheless, the need for accurate measurement and struggle for quantitative results, is common to all our scientific work regardless of field, for in the last analysis we must turn to measurements to arrive at a sense of proportion and to provide the data required to construct the statistics which may later reveal the laws of nature which we seek to discover.

When we consider what has been done already in the development of methods for measurement of distance, motion, temperatures, and compositions in the astronomical world, the amazing ingenuity and effort exhibited in nuclear research, which has brought about the possibility of measuring the mass and energy of infinitesimally small particles, traveling at speeds which no one can conceive, we begin to realize the wealth of material which can be drawn upon to effect measurements in scientific work. Those who have worked out methods to solve their own problems do not lack in interest in the applications of their methods to other fields, but are usually so absorbed in their own work and so unfamiliar with the problems of other scientific workers that relatively little cross application occurs.

INTERCHANGE OF TECHNIQUES

It is certainly not my thought to suggest that the engineer study medicine or undertake research in the medical field to be of service, or that the medical men take up engineering to be more useful, but rather to highlight the opportunity which we now have to utilize each other's techniques in our own work, to point to the common need of improving our methods and equipment for measurement as a fruitful area for the exchange of ideas.

Perhaps one of the most important factors in engineering progress has been the advent of the computing machine. It has assumed many forms from the simple desk calculator to the huge machine which can solve any form of differential equations and requires no less than a Ph.D. at the throttle.

During the war the use of computers expanded to a point where they were used for such complex purposes as the reproduction of flight characteristics of aircraft and guided missiles, the evaluation of tactical problems such as the probabilities of hits, deciphering of code, and innumerable uses which saved precious time and untold man power. The computer, of course, does not operate by itself. It is, in effect, a slave of the mathematician who works out the relationships to be examined. Mathematics, our oldest science, has been oftentimes considered aloof from the realities of practical work, largely because of the enormous labor entailed in obtaining specific answers from the theoretical relationships set up by the mathematicians. The gap between theory and practice has been bridged by the combination of the mathematician and the computer, which places at our command one of the most powerful tools ever devised.

The opportunity which we now have to obtain the answers to complicated relationships quickly and with little effort makes it possible for the first time to try out all sorts of combinations to establish trends or ferret out evidence of recurring patterns, no matter how obscure.

Today the combination of statistical mathematics and the computer not only plays a major role in research but is becoming an essential factor in industrial work.

The IBM machines, with which most people are familiar, are a form of computer. Their application to the analysis of plant operation and costs, which in turn point the way to future operations, is becoming a necessity. Analogue computers are now being built, which will permit forecasting the realization on the most complicated industrial processes in an incredibly short time. It is now actually possible to compare various proposed operations before actually engaging in them, thus, in effect, to make trial runs—and mistakes—at no cost.

Medical research may have great opportunities for mathematical-computer technique. It might be possible, for instance, to greatly simplify the statistical work required in determining the effect of certain drugs or treatment of certain diseases. The use of existing or special computers might not only reduce the physical time required in evaluating the data proper but, conceivably, reduce the number of cases required for a satisfactory statistical answer.

I do not feel competent to tell the medical profession just where computers can be used, but I am certain that consideration of existing mathematical equipment and methods will reveal application to medical research and practical work which will save precious time and man power. If answers appear sooner, the next step will come quicker and progress will be accelerated.

APPLICATIONS OF ENGINEERING TO MEDICINE

During the war, when we had to give thousands of physical examinations with an incredibly small staff of medical men, I was asked to develop a machine which would count the pulse of 25 or 30 individuals simultaneously while they exercised. With relatively little difficulty we developed and built an electronic device for such work which was used in aviation research. As a matter of fact, it is possible to develop a device for virtually any kind of routine work provided its characteristics can be specified. The question is: What is needed?

For instance, I was informed the other day that in cancer research it is now possible to obtain early warnings of cancer by the examination of body secretions, that, were it not for the tremendously laborious process of examining specimens under the microscope to determine cancerous cells, mass examinations could be made which would give an opportunity to tackle cancer in its early stages. I was also informed that, when dyed, cancerous cells take on a different color and have possibly other different and ascertainable physical characteristics. This would indicate the possibility of some photoelectric means of detecting the presence of such cells and perhaps lead to the development of an automatic device for the examination of specimens.

Again, I am informed that there is no simple way of obtaining blood counts, which are required in great numbers, in laboratories and hospitals, but that this must be done by trained technicians with the aid of a microscope, which involves much time and man power. It is conceivable that some form of electronic scanning device might be developed into a new tool to free technicians for other work and thus increase the effectiveness of treatment.

I do not presume to have a specific answer to such problems but I feel certain that if requirements of this nature could be formulated and passed on for consideration to engineers and industrial laboratories, the solutions might be forthcoming.

So far, engineers have not played much part in helping medical men in their war on disease, although it may be remembered that engineers and physicists were called upon during the war to assist in developing better prosthetic devices, improved hearing aids, and to provide devices for reading to those unfortunate casualties whose sight was impaired. Such work, however, does not represent the potential value of engineering co-operation. It is not because engineers are uninterested in such work, but because they do not know how they can help and because they do not know the problems. If some way can be found to make them aware of the technical needs of the medical field and enlist their help, I think you will find them ingenious, resourceful, and enthusiastic collaborators.

On the other hand, the medical profession has already played an important part in industry and engineering. Certainly the Panama Canal could not have been built without medical control of disease. In the war the elimination of such scourges as yellow fever and the battle against diseases and infections of all sorts were magnificent accomplishments, without which it would have been difficult to operate regardless of technical progress. In industry, too, health is being safeguarded and greater sense is being exhibited in selecting men for jobs due to the application of medical knowledge.

STUDY OF THE MEN WHO MAN MACHINES

With this work we are all familiar, but beyond it, there lies a vast new field in which medicine is beginning to play its part, the determination of the physical and mental capabilities of human beings who will be called upon to man the engines of the future.

Man, who has conquered the air, will fly in the stratosphere at incredible speeds. He may be subjected to extremes of temperature, acceleration forces, and supersonic vibration. His reaction time to events may be far exceeded. The question is: How far can he go? The machine, which has already exceeded man's capabilities, seems to have no limit; yet the human being remains constant and cannot be expected to change for many million years. If he is to man the machines of the future, to invade the air or the depths of the sea, to live in spite of new radiation and disturbances heretofore unknown, he must safeguard himself by training and shielding himself from circumstances with which he cannot cope. Such protection must be made part of modern design. It is up to you in the field of medicine to find out how much man can take and tell the engineer, or the machines which, in the future, will represent the progress of science, will spell futility.

In the field of psychology, we are only too aware of how little we know about men's minds. The study of the individual was greatly stimulated by the war and considerable knowledge

(*Continued on page 682*)

AMERICAN INDUSTRY

Democracy's ACE *in the* HOLE

By C. S. WYAND

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THERE are few people in America today who are not genuinely concerned about the conflict between communism and western civilization, and about the implications of that conflict for the United States and its citizens. Most of the discussion seems to center about the atomic bomb, the impression being that, if our military might is greater than that of Russia, the American way of life will prevail.

I doubt the validity of that view very much. Up to a point, the struggle between Russia and the so-called democracies is the old familiar conflict of nations as such. But, beneath the power politics, there is a centuries-old issue raised in modern times by Karl Marx and his successors. That issue is whether the average man stands to gain more by trusting individuals with the economic resources of the nation, or whether he would do better to hand everything over to the State and fit himself and his interests into a governmental plan of social and economic development.

We may agree among ourselves that individualism is obviously and demonstrably superior to any brand of socialism. But there are many people in this country who are not so sure of that as we are. There are many more throughout the rest of the world who are equally undecided. Hence winning another war would not make the world safe for our way of life. It would only do what winning the last one did, namely, give us one more chance to make the American way work so well that it will flourish through its own virtue.

The existence of widespread skepticism today suggests that we have not presented a convincing case for democratic individualism, although there is no question but that we have the latent power to do so if we will. To many people, America's hand in to-day's international stud-poker game looks only fair. Yet, I know we have an ace in the hole that will vastly improve that hand if we will only use it smartly. The ace is American industry; and in my judgment the future of this country will depend in large measure upon what engineers, who, in the last analysis, control American industry, do with the card that can turn a mediocre hand into a winning one.

NATURAL RESOURCES, MACHINES, AND FREE MEN

To most engineers it is inconceivable that anyone could question the productivity of American industry as it has been operated by free individuals. The whole world knows that within a few generations the initiative of such individuals converted a wilderness into a civilization where 6 per cent of the world's people now create 45 per cent of the world's annual total of goods and services to provide a standard of living undreamed of a century ago. Moreover, this vast outpouring of wealth grew as the length of the working day shrank from 14 hours to 8, and the physical demands on the worker's strength and endurance fell even faster.

Some of our critics have said that with all the natural resources we had at our disposal, we could not help growing rich. This is unfair. True, Nature did supply us bountifully with raw materials. But their development was a human achievement, the extent of which can be measured by the difference in the use made of those resources by the Indians and by ourselves. We and our ancestors applied to those raw materials three basic ingredients unknown to the Indian: i.e., (1) free well-trained labor; (2) a technology based upon the machine and artificial power; with the first two co-ordinated and fused into a productive force by (3) the ingenuity and daring of free management.

It was this combination of natural resources, machines, and free men that raised the output per man-hour in the manufacturing industries at an average annual rate in excess of 3 per cent for the 30 years from 1909 to 1939. Meanwhile, the purchasing power of the consumer's dollar rose more than a third, while both the variety and the quality of the products he was buying improved proportionately. It was this combination of natural resources, machines, and free men that enabled us during the recent war to double our annual national product in 4 years; to exceed the munitions production of our enemies by more than 50 per cent; to produce more than 40 per cent of the armament output of all the warring nations; and at the same time to hold the dollar value of consumer-goods production very near its prewar peak. To cap the climax, we also invested 25 billion dollars in new plant and equipment during those war years.

In the early years of peace we have dropped back from the wartime peak for obvious reasons. We could not keep old men, housewives, and school children working indefinitely; we could not expect to continue running men and machines on three 8-hour shifts, 7 days a week; nor have we now justification for producing without regard for cost. Nonetheless, our postwar production is in many lines still close to miraculous by prewar standards; and the rest of the world knows it.

Nations everywhere are besieging us both for goods and for the know-how to construct and use our machinery and methods. I will mention one case by way of illustration. The International General Electric Company, which handles General Electric Company's export and foreign business, had total sales in 1946 of over $50,000,000. This one company had 25 experts in 10 countries overseas, installing and servicing new and old equipment on contracts exceeding $20,000,000. Its men are are at work in Russia, Peru, Mexico, Sumatra, the Philippines, Saudi Arabia, Turkey, Chile, Brazil, and Argentina. Other cases by the score could be mentioned. However, enough has been said to make the point that we are the acknowledged leaders in industrial production in the world today.

PRODUCTIVITY IN RELATION TO LIVING STANDARDS

What more then does the world want in the way of proof that our free-enterprise system is superior to socialism in supplying the economic needs of the human race? The answer involves what at first sight seems to be a paradox. It grows out

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of the fact that there is a difference between high productivity and high production. Actually, advances in productivity are not a guarantee of increasing living standards. They constitute nothing more than increases in the nation's production potential.

"But," it may be said, "you yourself have just quoted figures demonstrating the tremendous output of American industry! Are such data not conclusive proof of our effectiveness?"

Up to a point, yes. The achievements of American industry are unprecedented. But the economic desires, unsatisfied desires, of vast segments of the American population are even greater. Beyond our own shores, the human need for the bare essentials of life is as tremendous as it is desperate. Rightly or wrongly, the exponents of socialism are saying to these frustrated people, "Switch systems, let the State take over, and your needs and desires will be satisfied."

We feel that such promises are cruel lies. But others are naive enough or desperate enough to believe the promises of the new economic messiahs. So, in my judgment, if we would preserve the American way, we must outproduce the socialist promises. We must prove by performance that free private enterprise can do even better than it has done thus far. Otherwise, I fear we may lose our birthright by default.

"But there is a limit to what even we can do!" is the retort.

True, but I don't believe we have reached that limit yet. There are opportunities for free enterprise ahead that dwarf the opportunities of the past. Perhaps some of us are overlooking these opportunities because we are putting undue stress on such limited measures of achievement as productivity per man-hour. High productivity does not necessarily mean a healthy economy. A high level of productivity may co-exist with only partial employment, as the depressed 1930's showed us all too clearly. To realize the advantages of high productivity for everyone, full employment and a large volume of output are necessary. If that is doubted, look at the record. Between 1919 and 1939, hourly wages rose 45 per cent in terms of real purchasing power. During the same period unemployment cut annual wage earnings 20 per cent in terms of real purchasing power. Capital also lost ground during those two decades. Total capital investment decreased 4 per cent, earnings fell 11.8 per cent. Does this not suggest that when the engineer has stepped up productivity only half of his job is done? Somehow he must make certain that output and employment keep pace with productivity. Otherwise what happened in England can happen here, and what happened in Russia can happen in England.

At this point, no doubt some readers are raising the question, "Why put the whole burden on engineers?" My answer is that expanded and sustained production are the primary bases for the survival of free private enterprise. Who but the engineers are capable of fostering these objectives?

"But how can we do more than we are doing now?" is asked. That question is suggested so that I might have an excuse to give my version of the answer.

HURDLES TO OVERCOME IN ATTAINING AN AGE OF PLENTY

In what follows I am going to ignore the very real prospect of war. I ignore it because war solves nothing, it only complicates the ultimate solution. Another war would bring us very close to bankruptcy even through we "won" it in the military sense.

There are three major hurdles to the future production of goods in quantities vast enough and at prices low enough to provide everyone with the essentials of life. The three hurdles are rising production costs, dwindling supplies of traditional raw materials, and growing governmental bureaucracy.

At the outset let me say that I see nothing to support the feeling now current that Americans must steadily draw in their belts and adapt themselves to an ever lower standard of living. I believe confidently that we are on the threshold of a new industrial revolution that will dwarf the eighteenth-century one if we will use the brains God gave us and do the job of development ourselves. But if we are going to do it, we had better get under way. There is much to be done and the time is short.

Rising Costs. During the war years many engineers had a brief respite from the grinding pressure of competitive costs. Now it is back on them again and most of us today find ourselves obliged to turn out products which will perform reliably through a long life, and to make these products available at the lowest possible first cost.

With price indexes rising, it is easy to excuse a rising price for our own product. But preserving the American way of life requires that we bend every energy to lower our selling prices even though costs are now trending upward. And it can be done. On this point let me quote the suggestions of an engineer who has impressed me as knowing what he was talking about:

"One means of cutting cost," he said, "is to engineer buildings, equipment, machinery, and processes as to save both the utmost space and weight, consistent with efficient operation and adequate accessibility..... Certain pumps, heat exchangers, and other machinery may frequently be mounted advantageously in vertical rather than in horizontal position. Continuous processes require materially less space than do batch ones and are lower in first cost. High steam pressures and temperatures result not only in lower fuel costs, but also in reduced weight and space requirements in steam plants. Many types of machinery, particularly power-generating equipment, have become so reliable that it is no longer necessary to provide spare or stand-by units."

In one case, consulting engineers were able (by rearranging production lines, speeding-up some operations, and replacing a small amount of obsolescent equipment) to double plant production and "at the same time to release one third of the existing floor space for future expansion. This was done in what was formerly considered to be an overcrowded plant."

Another factor in cutting cost is the judicious use of electric power because it is an enormous saver of both time and labor. Approximately 86 per cent of the horsepower used by manufacturers in this country is electric. Yet right now American industry is less than 50 per cent electrified in terms of using electricity for all operations it can do most efficiently and economically. Here the electric power industry has a chance to do its part. Evidence suggests that further reductions in the cost of such power will produce greater than proportional increases in its use. If private power companies won't do the job, public ones will. Read the history of the REA for an example of what such default produces.

Electronic equipment is an even more neglected source of production economies. At the present time probably less than 5 per cent of American industry is equipped with electronic devices it could use profitably. As a timer of stages in the production of all sorts of products from steel to rubber as a guard against the release of defective products, as an industrial safety device, electronic equipment is superior to human labor and infinitely cheaper.

A good traffic manager can realize significant savings by using modern transportation devices in ways which will speed up production and marketing time while reducing essential inventories and therefore the size of storage facilities.

New production methods are equally worthy of investigation. For instance, resistance welding, in which a fusion of metal parts is made by electrical resistance without the use of filler metals, was developed during the war and could now be applied profitably to a variety of peacetime uses. The economy

of this process is evident in the fact that one machine, spot-welding aluminum sheet metal in aircraft production, can make 100 welds per minute. The prewar riveting record was 800 rivets per man per 8-hour shift.

Consider one other example of the economy of modern production methods. At North American, a landing-gear casting which required the drilling of 100 holes formerly traveled 2 miles around the shop. Now the part is placed in a single jig and moved through 5 machines arranged in U-formation. The new jig replaces 16 machines and 16 men.

The evidence then is clear that the war stimulated the development of a vast variety of new machines and new production techniques which, if put to work, will enable private enterprise to reduce and keep its costs at levels which will permit even wider distribution of mass-produced articles. There can be no more effective reply to socialism than such an adjustment.

Dwindling Natural Resources. The planners have for years predicted the collapse of civilization with the exhaustion of our more accessible natural resources. The serious wartime drain on these reserves has added greater fervor to their alarms until now the most rabid of them will be content with nothing short of governmental seizure of our remaining reserves. This could happen if another war developed. But before it does happen, engineers of the nation can reduce the hysteria by making profitable industrial use of the more plentiful materials about us.

This is being done, and nowhere have shortages stimulated greater advances than in the use of the light metal alloys. The Army and the Navy have more or less set the pace in the use of magnesium alloys, and apparently their results suggest wide industrial uses for such alloys. Such increased use should lower the cost of the metals involved. All-aluminum automobiles, railroad cars, and locomotives, as well as magnesium-made articles ranging from wheelbarrows to textile machinery are, I understand, already on the drawing boards and, in a few cases, actually in production. Another interesting example was reported recently. The International Nickel Company announced the development of a practical 4000-ton extrusion press producing tubes of nickel and steel alloys. This engineering development makes possible for the first time the economical production of tubes and profiles in special alloys of steel and nickel.

As for the petroleum shortage, the Pittsburgh Consolidation Coal Company has erected a laboratory and pilot plant to produce liquid fuel oil and gasoline from coal. Along the same general lines, the Locomotive Development Committee of Bituminous Coal Research, Inc., has for the past 2 years been carrying on an intensive research program which is now culminating in the building of two large coal-burning gas-turbine locomotives. This process is economical as well as conservational, for the coal-fired gas turbine operates at about one third the cost of the conventional steam locomotive. "It is believed," says one report, "that the coal-burning gas turbine will find application in land and marine power plants as well as on the railroads, because of its unique ability to produce power at good efficiency from low-cost fuel without the necessity of using water."

I don't believe it is necessary to belabor this point further. The fact is that, while some of our natural resources are petering out, there is yet untold wealth in our hills and valleys awaiting the know-how for their development and profitable use. Even the materials we have used for generations are only partly used because we know so little about them. Although petroleum is the base of a multibillion dollar industry and literally the foundation of the machine age, Dean Steidle of our School of Mineral Industries tells me that at the present time almost nothing is known about its composition. It is estimated that science is now familiar with only about one tenth of one per cent of the components of this enormously complicated mixture. Obviously, if we know very little about any material, we will get relatively little service from its use.

In my judgment, therefore, the cry of exhausted resources is as invalid as the despair over costs. We've got in this country everything we need to meet the challenge of socialism if we will use what we have and use it intelligently.

Government Bureaucracy. I come now to the third and final obstacle to constructive postwar adjustment. No man in business today needs be told the costly, irritating, and destructive effects of governmental interference with private enterprise. And yet, ironically enough, the businessman has helped pull this hair shirt on himself. Group after group of industrialists has turned to Government for the protection of personal advantage, and then complained at the consequences of others doing likewise. The system of protective tariffs, the price maintenance and fair-trade laws, such agencies as the Reconstruction Finance Corporation, all exist because business wanted the personal advantages they created. Why then complain about the bureaucratic price? For it is obvious that, if Government does any job, we must pay the cost of the job plus the cost of maintaining an administrative bureaucracy in which political considerations invariably outweigh economic ones. Generalizations are always inept, but in my judgment Government by its very nature is incapable of efficient operation. It is just not set up to operate as competitive private enterprise must operate if it is to survive.

That is precisely why I am so certain that no socialistic system can compete economically with a private-enterprise system such as our own. We as individuals can outproduce any governmental system ever devised if we will assume the obligations which go with the rights of free men.

Our trouble today is that we refuse to assume those obligations—obligations needed to keep the economy on an even keel and producing both jobs and goods at high levels. I submit for instance that profits in recent years have been too high for economic stability and that the distribution of some of those earnings to the public in the form of lower prices would have worked to everyone's advantage including the producers'. I submit that the perversion of local, state, and National Government to private ends is not the way to keep government responsible and orderly. And I submit that the way to keep Government out of business is to keep Government out of business by looking after our own affairs privately and personally.

The major flaw in socialism, and it is a fatal one, is the mistaken notion that groups do anything. Achievements are the product of individual effort. Nothing was ever done except by individuals. Sometimes individuals work together but, where they are most successful, they work not as a group but as a team of freely co-operating individuals. None of this is new. It is the very essence of the American tradition. But we forget it or we lose sight of its implications.

AMERICA'S ACE IN THE HOLE

American industry is democracy's ace in the hole, not as a forger of weapons of war, but as a mighty productive force which alone can give the world a decent standard of living at a reasonable human price. If we believe this to be so, if we follow the traditional precepts of an economy of individual initiative and private enterprise, I believe we can defeat the enemy at our gates without firing a shot. If we desert these fundamentals, nothing, not even the atomic bomb, can save the American way of life and what it stands for.

FLUID-FLOW DIAGRAMS

Construction to Include Velocity Head

By GEORGE P. LOWEKE

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CURVES of the type shown in the accompanying figures are commonly used in the determination of flow for compressible and noncompressible fluids. The velocity head, which is frequently desired in flow problems, can be incorporated in these flow diagrams by the addition of a velocity axis having a slope adjusted to read the velocity head on the scale provided.

For this purpose the velocities are designated along a V-axis. By reference to this axis along a line parallel to the velocity lines, the corresponding head can be read opposite the flow or slope axis as the case may be. Fig. 1 illustrates the method for the well-known Manning diagram. To extend the usefulness of the chart in determining the velocity head corresponding to any velocity, a 10 *V*-axis is included for velocities ten times as great. Through the use of these two axes and properly placing the decimal point the velocity head corresponding to any velocity can be found.

Fig. 2 illustrates the method applied to the curve by F. C. Scobey for the graphical solution of the Chezy formula with the Kutter *C*. On this curve the 100 *V*-axis is also shown. This axis yields the same numerical values, except for the decimal point, as the *V*-axis. With the aid of this line the low velocities are included without the necessity of extending the whole chart to the left.

The same method can be applied to other flow charts on which the velocity head is omitted but the velocity is shown by a system of parallel lines.

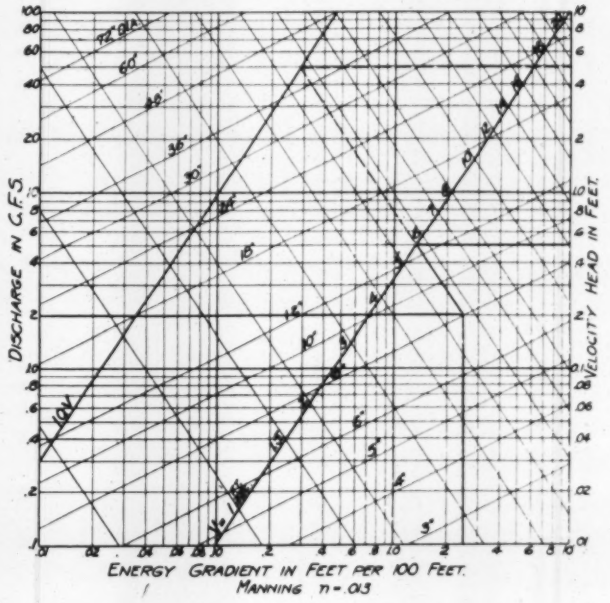


FIG. 1 CURVE FOR SOLUTION OF MANNING FORMULA SHOWING A HEAD LOSS OF 2.5 FT PER 100 FT, AND A VELOCITY HEAD OF 0.5 FT CORRESPONDING TO A DISCHARGE OF 2 CU FT PER SEC THROUGH AN 8-IN-DIAM PIPE

(Dotted line indicates velocity head corresponding to velocity 10 times that in pipe.)

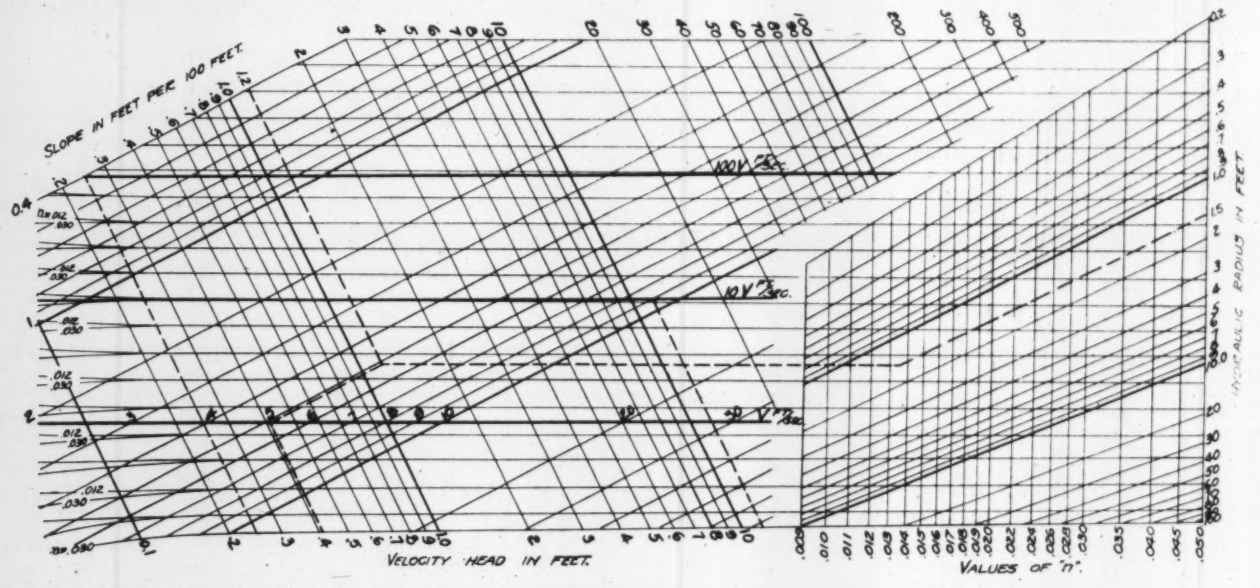
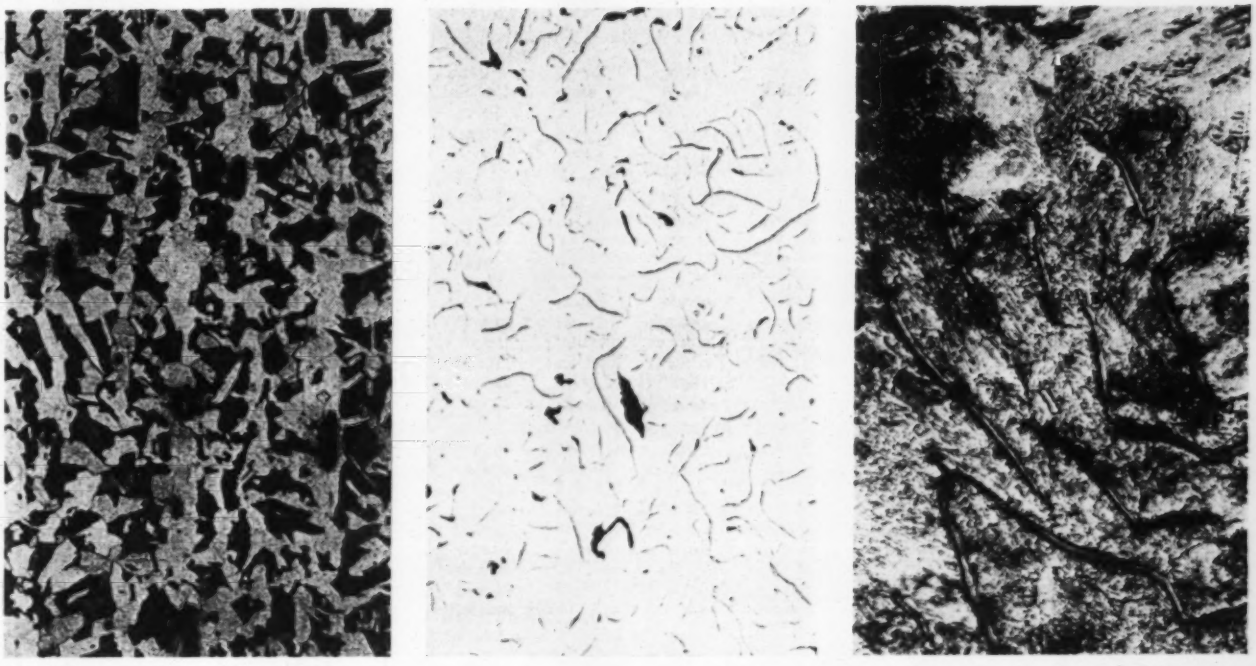


FIG. 2 CURVE BY F. C. SCOBEY FOR SOLUTION OF KUTTER FORMULA MODIFIED TO INCLUDE VELOCITY HEAD

(Given an hydraulic radius of 1.5 ft for value of $n = 0.0135$ and slope of 1.2 ft per 100 ft, the corresponding velocity is 5.15 fps, with a velocity head of 0.41 ft. For $V = 90$ fps, from the 10 *V*-axis the velocity head is 125 ft, and for 0.4 fps the velocity head from the 100 *V*-axis, after placing the decimal point properly, is 0.0025 ft.)



(*a*) (*b*) (*c*)

FIG. 1 SIMILARITY AND DIFFERENCES BETWEEN STEEL AND GRAY IRON

(*a*, 0.30 per cent C steel; ferrite, white and pearlite, dark, nital etch; × 500. *b*, Gray iron showing graphite and metal, unetched; × 100 *c*, Same gray iron showing graphite and pearlite, nital etch; × 500.)

Unappreciated Advantages of MODERN GRAY IRON

By FREDERICK G. SEFING

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AN engineer's appreciation of modern gray iron is as much an understanding of the characteristics of gray iron itself as it is an understanding of the advancements made in modern gray irons. At the outset, it is well to define gray iron simply and clearly. It is essentially a steel interspersed with 1.5 to 3.5 per cent of graphite. Fig. 1 illustrates the similarity and difference between steel and gray iron. Essentially the peculiar properties attributed to this metal, steel plus graphite, are associated indeed with the form and the amount of graphite present, the greatest amount of graphite being associated with the ASTM class 20 iron, and the least amount of graphite with the highest-strength class.

The outstanding properties of gray iron which are an improvement over those of steel are resistance to wear and galling (Fig. 2), improved resistance to corrosion by water and by heat, less tendency toward warping under heating and cooling, increased capacity to dampen vibration (Fig. 3), high notch fatigue (Fig. 4), compression and torsional strength, to some extent increased electrical resistivity, and, finally, low cost of forming, and very good machinability. On the other hand, there are some properties which are definitely lowered by the presence of graphite, notably, a reduction in tensile strength, reduced stiffness or modulus of elasticity, and a low order of toughness.

RANGE OF PROPERTIES OF MODERN GRAY IRON

Comparisons between medium- and high-strength gray irons (Table 1) show that high-strength irons can be made to have about twice the toughness and greater stiffness, at the same time retaining good wear, machining, and damping properties. With different types of gray irons, which can be specified suitably, a variety of resistance to metal-to-metal wear can be achieved. Specifying AFA Type A graphite and all pearlite in the metal structure assures optimum wear properties.

It is essential to note that those gray irons with the high strength range and other properties attainable at extreme levels are associated with alloy additions. This is not surprising, since it is well known how the extremes in combinations of properties are achieved in alloy steels, as compared with those attainable in plain steels. Similarly, the high mechanical properties of the better gray irons can be obtained with alloy additions and without the need of heat-treatment, whereas in

Presented at a meeting of the Metropolitan Section, New York, N. Y., March 2, 1948, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

TABLE 1 GENERAL ENGINEERING GRADES OF GRAY IRON—PHYSICAL PROPERTIES

Class	30	35	40	45	50	60	70	80
Tensile strength, psi (min)	30000	35000	40000	45000	50000	60000	70000	80000
Transverse strength, load, lb	2200	2400	2600	2800	3000	3400	3800	4600[a]
1.2-in-diam bar, deflection, in.	0.20	0.20	0.22	0.22	0.24	0.26	0.30	0.34[a]
Compressive strength, psi	105000	115000	125000	135000	150000	175000	200000	225000
Torsional strength, psi	40000	45000	54000	60000	67000	76000	85000	90000
Modulus of elasticity,[b] psi $\times 10^{-6}$	14	15	16	17	18	19	20	21
Torsional modulus, psi $\times 10^{-6}$	....	....	5.5	6.6	7.0	8.0	8.1	....
Impact strength, Izod AB (1.2-in-diam unnotched) ft-lb	23	25	31	36	65	75	120+	120+
Brinell hardness	180	200	220	240	240	260	280	300
Endurance limit, psi:								
Smooth	15500	17500	19500	21500	25500	27500	29500	31500
Notched	(13500)	(15500)	17500	(19500)	21500	23500	25500	27500
Damping capacity	Excellent	Excellent	Excellent	Good	Good	Good	Fair	Fair
Machinability	Excellent	Excellent	Excellent	Good	Good	Fair	Fair	Fair
Wear resistance	Fair	Fair	Good	Good	Excellent	Excellent	Excellent	Excellent
Pressure tightness	Fair	Fair	Good	Good	Excellent	Excellent	Excellent	Excellent
Specific gravity								
g per cc	7.02	7.13	7.25	7.37	7.43	7.48	7.51	7.54
lb per cu in.	0.254	0.258	0.262	0.267	0.269	0.270	0.272	0.273
Thermal coefficient of expansion: (in. per in.) $\times 10^{-6}$ (50–200 F)	6.5–6.7	....	6.6–6.8	6.4–6.4	....	....	....	....
(50–500 F)	6.9–7.2	....	7.1–7.3	6.8–7.0	....	....	....	....
(50–800 F)	7.4–7.6	....	7.4–7.6	7.0–7.2	....	....	....	....
Magnetic properties	Mag.	Mag.	Mag.	Mag.	Mag.	Mag.	Mag.	Mag.
Pattern shrinkage, in. per ft	1/10–1/8	1/8	1/8	1/8	1/8	1/8–3/16	1/8–3/16	1/8–3/16
Coef. of friction (against steel)	....	....	....	(0.19)	(0.195)	(0.20)	..	....

NOTE: Values in ( ) estimated. [a] Questionable values. [b] At 25 per cent of tensile strength.

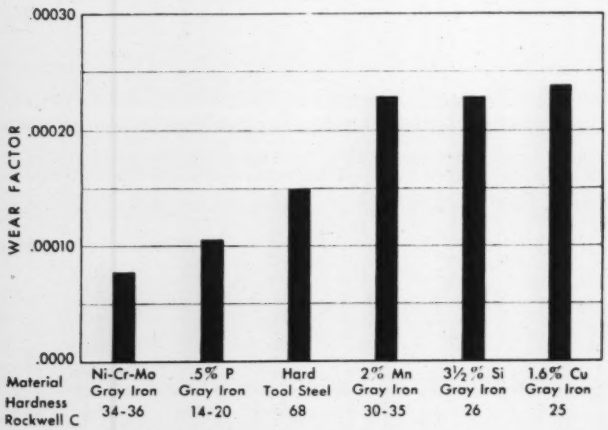

FIG. 2 COMPARISONS OF WEAR OF VARIOUS CAST IRONS AND HARDENED TOOL STEEL

(ASTM Symposium on Wear, by Jominy, 1937.)

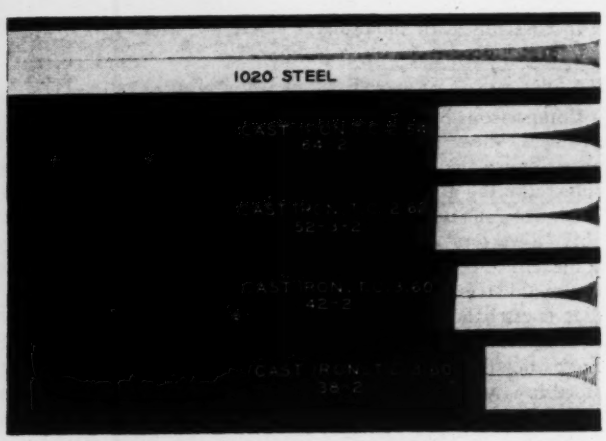

FIG. 3 VIBRATION-DAMPING CAPACITY OF SOME GRAY IRONS AND SAE 1020 STEEL

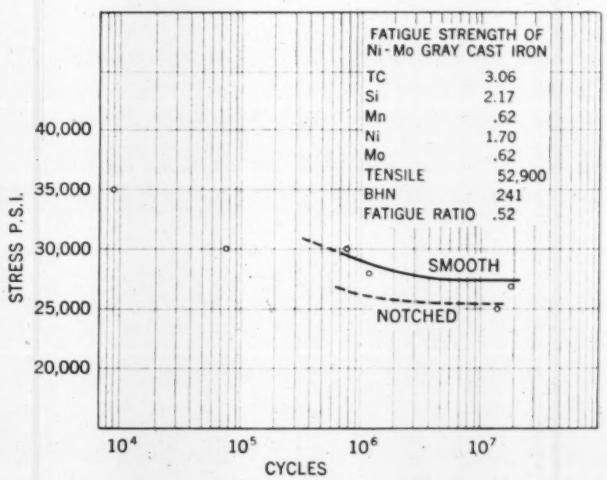

FIG. 4 NOTCHED-FATIGUE TESTS SHOW LITTLE REDUCTION IN ENDURANCE LIMIT OF GRAY IRON

(Notched-fatigue values of steels are generally 25–35 per cent of tensile strength.)

steels the higher mechanical properties are associated with heat-treatment.

In general, then, the strength of gray iron, which commonly is of the order of 20,000 to 30,000 psi tensile strength, can be increased to levels of from 40,000 to 70,000 to 90,000 psi tensile strength by the addition of from 1 to 4 per cent of suitable alloying elements such as nickel, chromium, molybdenum, vanadium, and copper. Furthermore, these high-strength irons show improvements in many properties other than strength. Foundries of the better class have established their techniques to provide the more improved types of gray irons, so that the ASTM classes of irons ranging from 40,000 to 70,000 psi tensile strength, with optimum wear resistance and the like can be supplied readily.

Marked improvement to corrosion resistance can be achieved with rather heavy alloy additions of from 20 to 35 per cent nickel. This group of irons known to the trade as "Ni-Resist"

TABLE 2 COMPARATIVE CORROSION RATES

	Nickel austenitic cast iron	Ordinary cast iron
Bad boiler water (203 F)	1	6
5 per cent sulphuric acid (cold)	1	475
5 per cent hydrochloric acid (cold)	1	107
Sea water	1	5
Hot caustic soda	1	8

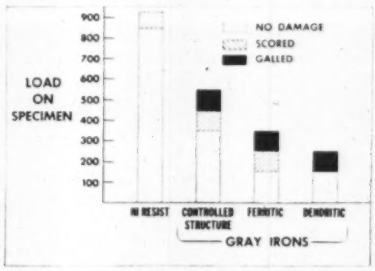

FIG. 5 GALLING TESTS

(Ni-Resist: 20 per cent nickel, 2 per cent chrome. Controlled structure: AFA Type A graphite, fully pearlitic. Ferritic: 140-175 Bhn gray iron. Dendritic: AFA Type D or E graphite.)

is as different from gray iron as the austenitic 18-8 stainless steel is from plain steels. The corrosion rates of Table 2 and Fig. 5 show some of the outstanding differences between these high-nickel-alloy irons and gray iron.

ENGINEERING APPLICATIONS OF GRAY IRON

Some outstanding examples of engineering applications of gray irons are given which do a job that it would be relatively difficult to do with any other low-cost metal. These are arranged in three groups, the first of which requires resistance to wear as the outstanding property. Piston rings for engines and pump pistons are most commonly made in gray iron because of the need for resistance to wear, corrosion, and heat, and high vibration-damping capacity. Motor blocks and engine and pump cylinders require resistance to wear and corrosion and high damping capacity, together with a low cost of forming the metal to the desired shape. One of the outstanding and rather colorful examples of applying modern gray iron is in engine and compressor crankshafts. They are used in small compressors, automotive engines, and indeed, in large Diesel engines such as the submarine Diesel, where the gray-iron crankshafts weigh up to 10,000 lb, Fig. 6. The use of gray iron in crankshafts is for the high vibration-damping capacity, a high notch-fatigue strength of the metal, good wear properties on the bearings and the low cost of forming or founding and machining to the desired shape, as compared with forging and machining. For example, a forged-steel crankshaft weighed 18,000 lb, and when ready for installation, 14,000 lb (4000 lb removed). The gray-iron crankshaft for the same engine weighed 10,000 lb as cast, and 9200 lb after machining.

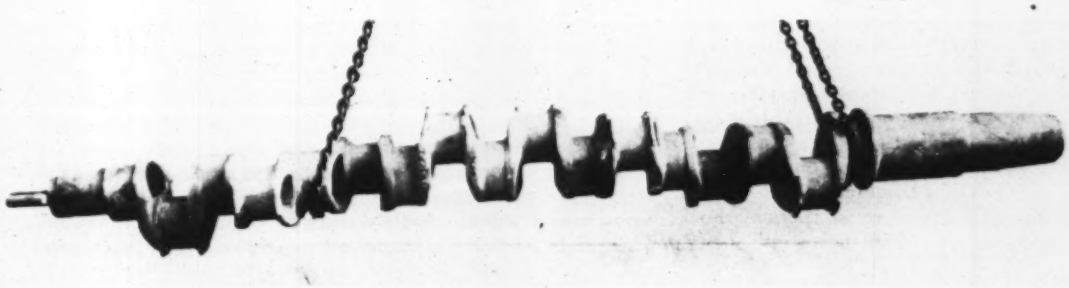

FIG. 6 HEAVY NICKEL-MOLYBDENUM-CHROMIUM GRAY IRON

Tensile strength 65,000-75,000 psi; two 10-in. sections. Courtesy Campbell, Wyant, and Cannon Foundry Company, Muskegon, Mich.)

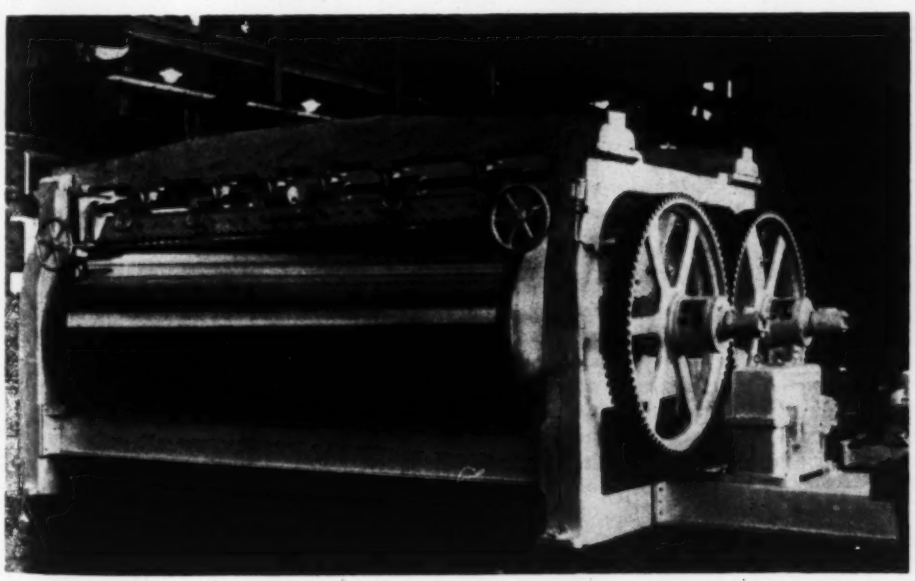

FIG. 7 CAST-IRON DRUM DRIERS FOR RESISTANCE TO WEAR AND MILD CORROSION

A second group of applications involving corrosion resistance in gray iron is illustrated by paper-mill, textile, and food roll driers (Fig. 7), where resistance to corrosion against steam and frequently resistance to wear are very important. Here again the low cost of forming or founding to the desired shape is an important factor. Other ex-

amples involving more complicated designs are kettles and evaporators where the temperatures employed in gray iron are up to 650 F. In these applications, resistance to corrosion, occasionally resistance to wear, and low cost of acquiring the desired shape are afforded by modern gray iron. Indeed, in such applications the low modulus of elasticity of gray iron, of the order of one half that of steel, is taken advantage of by holding down thermal stresses. In filters of the drum type or filter-press plates, resistance to corrosion and low cost of forming are important factors in favor of cast iron. Valves, pumps, and pipe are common examples of cast-iron applications utilizing the combination of resistance to wear and corrosion, and low cost of forming to the desired shape. Another common application, and one of the large outlets for gray iron, is in furnace parts. The fair level of resistance to heat of ordinary gray iron can be improved upon by the addition of alloys, usually chromium and nickel; when these are added in sufficient amounts, 22–25 per cent, the heat resistance is of a high order.

A third group of heavy-duty uses of modern gray iron is illustrated in the following: Gears, where high strength and high damping-vibration capacity, together with good resistance to wear, are needed; and machine-tool castings, where high vibration-damping capacity and good resistance to wear on the metal-to-metal contact in the ways make gray iron a necessity to afford the great accuracy required. Another outstanding example where advantage is taken of a combination of strength, wear resistance and improvement to resist thermal shock, is in brake drums, Fig. 8, as applied to motorcars, including passenger

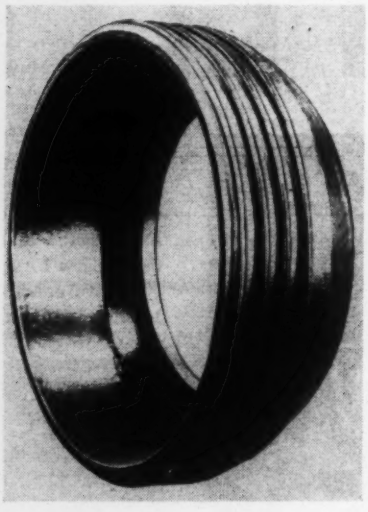

FIG. 8 NICKEL-MOLYBDENUM-CHROMIUM-ALLOYED GRAY-IRON TRUCK BRAKE DRUM

cars and heavy-duty trucks, and the extreme case of gray-iron brake drums for heavy-aircraft landing brakes. Metal-forming dies (Fig. 9), and rolls require a high level of strength combined with resistance to wear and vibration-damping capacity.

The examples given, in general, are peculiar to gray iron be-

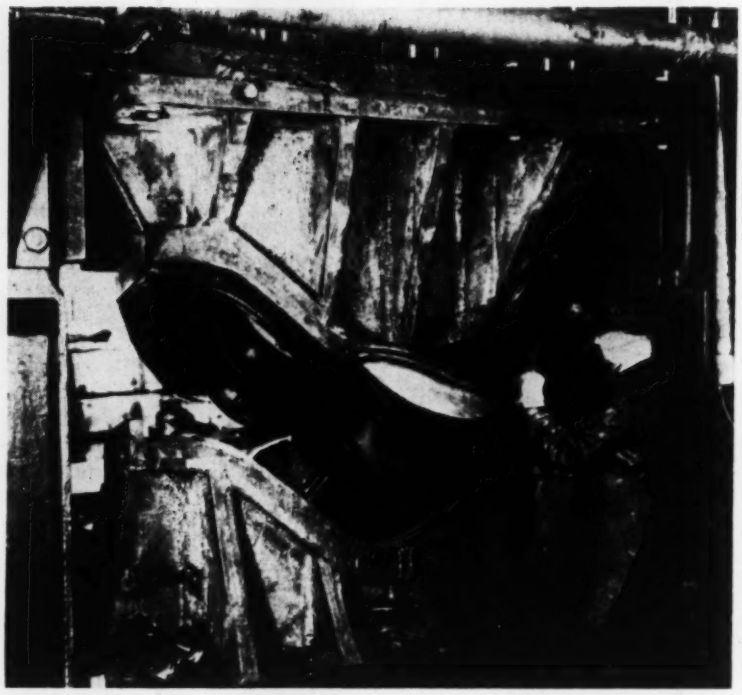

FIG. 9 CHROME-NICKEL-MOLYBDENUM GRAY IRON IN 8-TON AUTOMOBILE-FENDER FORMING DIE
(Courtesy, General Motors Corporation of Canada.)

cause of the presence of graphite to afford wear resistance, high vibration-damping capacity, moderate resistance to corrosion, and equally important with these useful engineering properties are the low cost of founding, which produces parts with small machining tolerances, and ready machinability.

LIMITATIONS OF GRAY IRON

It is important, when discussing any particular commodity or material, that its limitations be recognized along with its advantages. Where pure tensile strength is involved such as in tie bars, rolled steel bars are cheaper and better than any type of gray iron that might be considered. Where resistance to sudden, heavy loads is required, such as in axles of vehicles, gray iron should not be considered because of the low order of impact values of gray iron. While considering toughness, which is a qualitative term, some differentiation should be made between impacts and vibrating loads. In a crankshaft, for example, where the load is a vibrating one, the high vibration-damping capacity of graphite-containing gray iron is an advantage which has been found very useful in preventing load amplification.

When an engineer is considering design features of machinery, chemical equipment, and the like, the favorable features of gray iron to consider are metal-to-metal wear resistance, high vibration-damping capacity, low cost of securing complicated designs, and low machining costs. The high notch-fatigue values of modern gray iron make it an important metal to consider in competition with some of the more expensive and apparently better metals for many machine parts. Indeed, when gray iron is being considered, it is to achieve economically a combination of properties which it would be difficult to find in any other metal.

SPECIFYING GRAY IRON

In specifying gray iron, the engineer should include those

(*Continued on page 674*)

PERMANENT-MAGNET MATERIAL

By J. H. GOSS[1]

GENERAL ELECTRIC COMPANY, WEST LYNN, MASS

THE development during recent years of a number of permanent-magnet materials, characterized by greatly increased energy value per unit of weight, has centered a considerable amount of attention upon their design possibilities for other than purely electrical applications.

Until about 1932 the best permanent-magnet material available was 36 per cent cobalt steel. This material represented a gain over the 1 per cent carbon steel originally used of 4.9 times the energy value per unit of weight. This compares with Alnico V which is in general commercial use today and which has an energy value of 26 times that of 1 per cent carbon steel.

The number of materials available has grown from 5 to over 20 during the last 20 years and the mechanical properties of the materials are no longer confined to the hard brittle structures which characterized permanent magnets up to the middle 30's but now include materials quite ductile in their final magnetic state.

TYPES OF ALLOYS

Table 1 has been prepared to bring together the general information on 21 permanent-magnet materials. In general, these materials may be divided into four groups, as follows:

Quench-Hardening Steels. The first five materials listed in the table can be classified as quench-hardening steels and contain in the order of 1 per cent carbon as the hardening agent. The materials must be quenched to develop their optimum magnetic properties. The final structure is hard and brittle, making it necessary to do all fabrication except that which can be done by grinding before the final hardening.

Carbon-Free Alloys of the Alnico Type. The materials listed in Table 1 beginning with No. 6 and including No. 12 are of the aluminum-nickel-iron group and are commonly called the Alnicos. These alloys contain no carbon except as an impurity. They depend for their hardness upon intermetallic compounds formed when cooled from a high temperature at a controlled rate.[2] Optimum properties are obtained in some cases by reheating to a temperature of 600 to 700 C. For example, alloy No. 8 (Alnico III) is heated to 1200 C and quenched, after which it is aged at a temperature of 700 C.

These alloys as a group are comparatively weak and brittle. They must be cast or sintered to final shape except for modifications in shape which can be obtained by grinding.

Machinable Alloys. The materials in Table 1 beginning with No. 13 (Cunife I) and including No. 19 (Silmanal) may be machined in their optimum magnetic state.

With the exception of Vectolite and Remalloy, these materials can be machined in their final magnetic state and are also quite ductile.

In all of these alloys the desired magnetic properties are obtained by a heat-treatment at a high temperature followed by a quench and subsequent aging at an intermediate temperature.

The Cunife and Vicalloy materials require cold-working between the quench and draw for the development of their optimum magnetic properties. They develop these optimum properties in the direction of maximum cold work which for sheet or strip is, of course, lengthwise. The Cunifes require for best results a 90 per cent cold reduction. Obviously, this is a limitation on the stock sizes which can be produced economically and also a limitation on the final shapes which can be made.

Remalloy may be readily worked by rolling or forging after the quench, but requires a 650 C aging treatment to develop its optimum magnetic properties. After this aging, it is hard and brittle.

Vectolite is an unusual material in several respects. It is a compound of oxides of iron and cobalt and has quite high electrical resistance. The density is approximately one half that of iron. It is relatively brittle at all stages of manufacture, but may be compared with soft sandstone for its general mechanical properties.

Precious-Metal Alloys. The materials in Table 1 from No. 19 through No. 21 use precious metals. With the exception of No. 19 (Silmanal), they have been little used because of their high cost.

These materials are essentially nondirectional in so far as their magnetic properties are concerned.

Silmanal has been used and probably will continue to be of real interest for special applications. It is very resistant to demagnetizing forces due to its high intrinsic value of coercive force. It can be used in conjunction with a restoring force such as a spring to indicate magnetic-field strength. One interesting and novel example of its application is a compass in which the needle is magnetized across its thickness, and the long direction of the needle therefore points east and west rather than north and south.

The platinum alloys are, of course, the most expensive alloys to produce. Due to this limitation their use will undoubtedly be confined to very special applications.

DEMAGNETIZATION CURVES

While Table 1 contains a summary of the properties of the various materials, the essential information that is required for design work must be obtained from the demagnetization curve, that is, the second quadrant of the hysteresis loop. For design purposes, a reproducible curve must be chosen and quality control exercised in the manufacturing process to insure the reproduction of minimum quality for production runs.[3]

A typical demagnetization curve for the Alnicos is shown in Fig. 1. The point-to-point product of $B \times H$ is plotted on

[1] Engineer in Charge of Works Laboratory, West Lynn Works.

[2] "Physics in Industry—Magnetism," by A. J. Bradley and A. Taylor, Institute of Physics, 1937.

Contributed by the Metals Engineering Division and presented at the Fall Meeting, Boston, Mass., Sept. 30-Oct. 2, 1946, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[3] "Permanent Magnets," by J. H. Goss, *Metals & Alloys*, vol. 15, April, 1942, pp. 576-582.

TABLE 1 ENGINEERING DATA FOR 21 TYPES OF PERMANENT MAGNETS

Mat'l. no.	Trade name	Typical composition, per cent	Coercive force, oersteds	Resid. induction, gauss	Maximum energy, $(B \times H)$	Rel. magnetic energy per unit weight	Rel. cost magnetic energy per $ raw material	Magnetizing force, oersteds	Mech. properties in magnetic state	Commercial methods of fabrication
1	1.00% Carbon	1.00 C, bal. Fe	50	8500	180000	1.0	0.18	300	Hard Strong	Hot forge, punch, machine
2	3½% Chromium	3.5 Cr, 1 C, bal. Fe	65	9000	290000	1.6	0.10	300	Hard Strong	Hot forge, punch cast, machine
3	5% Tungsten	5 W, 1 C, bal. Fe	65	10000	320000	1.6	0.39	400	Hard Strong	Hot forge, punch, machine
4	15% Cobalt Chromium	0.9 C, 10 Cr, 15 Co, bal. Fe	200	8200	650000	3.4	...	1000	Hard Strong	Hot forge, punch cast, machine
5	36% Cobalt Chromium Tungsten	0.85 C, 36 Co, 3.5 Cr, 3 W, bal. Fe	210	9000	930000	4.9	0.66	1000	Hard Strong	Hot forge, punch, cast, machine
6	Alnico I	12 Al, 20 Ni, 5 Co, bal. Fe	400	7100	1400000	8.7	0.13	2000	Hard Brittle	Cast, sinter, grind
7	Alnico II	10 Al, 17 Ni, 12.5 Co 6 Cu, bal. Fe	540	7200	1600000	9.7	0.18	2000	Hard Brittle	Cast, sinter, grind
8	Alnico III	12 Al, 25 Ni, bal. Fe	480	7100	1400000	8.7	0.09	2000	Hard Brittle	Cast, sinter, grind
9	Alnico IV	12 Al, 28 Ni, 5 Co, bal. Fe	700	5200	1300000	5.1	0.15	2000	Hard Brittle	Cast, sinter, grind
10	Alnico V	8 Al, 14 Ni, 3 Cu, 24 Co, bal. Fe	575	12000	4500000	26.4	0.095	2000	Hard Brittle	Cast, grind
11	Alnico VI	8 Al, 14 Ni, 3 Cu, 24 Co, 1 Tl, bal. Fe	750	10000	3500000	20.6	...	...	Hard Brittle	Cast, grind
12	Alnico XII	8 Ti, 18 Ni, 35 Co, 6 Al, bal. Fe	1000	5800	1800000	10.1	...	3000	Hard Brittle	Cast, grind
13	Cunife I	20 Ni, 60 Cu, 20 Fe	600	5800	1960000	9.8	0.09	2400	Ductile Malleable	Cold roll, machine punch
14	Cunife II	50 Cu, 20 Ni, 27.5 Fe, 2.5 Co	250	7300	780000	3.9	...	2400	Ductile Malleable	Cold roll, machine punch
15	Cunico	41 Co, 24 Ni, 35 Cu	710	3200	850000	4.4	0.655	3200	Ductile Malleable	Cold roll, machine, punch, cast
16	Vectolite	30 Fe_2O_3, 44 Fe_3O_4, 26 Co_2O_3	900	1600	500000	7.8	0.44	4800	Soft Brittle	Sinter, grind, machine
17	Vicalloy	52 Co, 10 V, bal. Fe	300	9000	1000000	5.5	...	1500	Ductile Malleable	Cold roll, machine punch
18	Remalloy	12 Co, 17 Mo, bal. Fe	240	10300	1100000	5.8	0.32	1000	Hard Brittle	Forge, cast, grind machine
19	Silmanal	86.7 Ag, 8.8 Al, 4.5 Mn	jHc 6000	B_r 550	85000	0.4	6.12	20000	Ductile Malleable	Cold roll, machine punch
20	Platinum Iron	77.8 Pt, 22.2 Fe	jHc 1570	5830	2280000	5.4	...	20000	Hard Brittle	Cast, grind
21	Platinum Cobalt	76.7 Pt, 23.3 Co	jHc 2650	4530	2400000	5.6	...	20000	Hard Brittle	Cast, grind

the right-hand side. This is called the energy value and when divided by 8π reduces to ergs per cubic centimeter.

PERMANENCY OF MAGNET STRENGTH

A great deal of misinformation can be obtained from the literature regarding the permanency of magnets. In general, properly processed magnets are inherently quite stable with respect to time unless acted upon by a demagnetizing force in excess of that provided for in the stabilizing treatment.

By stability is meant the constancy of the flux of the magnet with respect to time.

A good example of what can be done with permanent magnets is provided in the damping magnet of a domestic watt-hour meter, Fig. 2. As a result of carefully worked out manufacturing procedures, these magnets can easily be demonstrated to be constant to within a few one hundredths of one per cent per century. This can be shown by accurate measurements of the drift rate.[4]

In general, two conditions must be satisfied for stabilizing a magnet properly. One is called "metallurgical stabilization," and the other is called "magnetic stabilization."[4] The first is typified by the materials in the quench-hardening group (Table 1, materials Nos. 1 to 5, inclusive). A low-temperature heat-treatment after hardening is necessary to yield a stable structure. Some materials do not require the metallurgical stabilizing treatment, but if it is necessary to have a high degree of stability, this effect should be considered.

If the magnetic stability is satisfactory, the magnets will be stable unless acted upon by a demagnetizing effect. The stabilizing treatments applied after magnetization are for the purpose of insuring "magnetic stability." The usual demagnetizing influences which must be considered are (*a*) temperature changes, (*b*) external fields.

The magnet should be subjected to a demagnetizing field after saturation which is in excess of the maximum field expected to be encountered in service. If no specific demagnetizing field is expected, a safe practice will probably be to apply a field that will reduce the flux approximately 5 per cent below the saturated value.

Small changes in flux may occur as a result of temperature

[4] "Braking Magnets for Watt-Hour Meters," by I. F. Kinnard and J. H. Goss, Trans. AIEE, vol. 60, 1941, pp. 431–439.

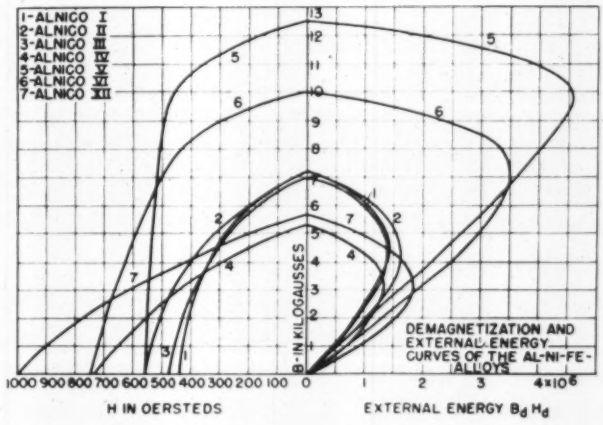

FIG. 1 DEMAGNETIZATION CURVE FOR THE ALNICOS

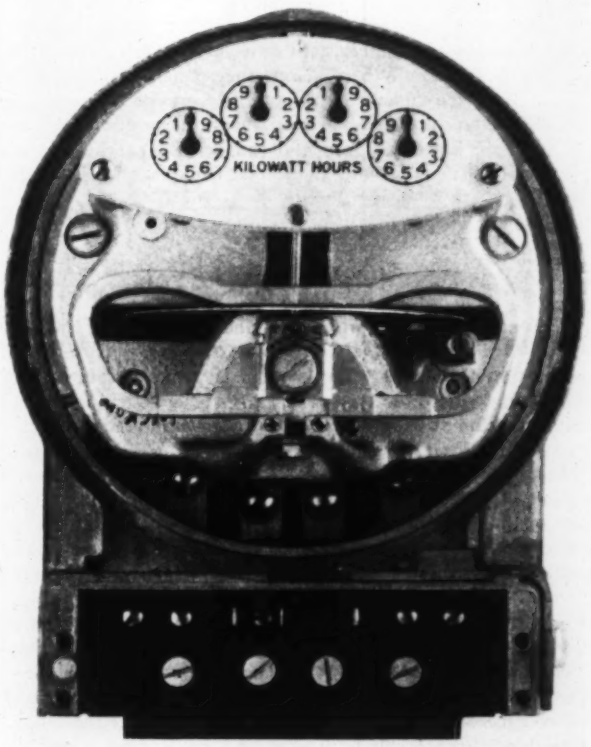

FIG. 2 DOMESTIC WATTHOUR METER

cycles. If the ultimate in stability is desired, the magnet should then be cycled for one or more cycles outside the temperature range over which it will be used. This effect for the majority of magnets is small and will not exceed 1 or 2 per cent of the total flux.

While the flux of a permanent magnet will vary with ambient temperature, increasing with decrease in temperature, and decreasing with rise in temperature, the effect is small and for magnets stabilized properly entirely repeatable. For the majority of materials this ambient-temperature coefficient is approximately 0.025 per cent in flux value per deg C. In Alnico V, this value may be as high as 0.05 per cent per deg C.

Sometimes it develops that magnets, treated as described in the foregoing, are erratic and unstable. This lack of stability can always be traced to the magnet's having been subjected to further demagnetization, often unwittingly. This, no doubt, has led to much of the erroneous information regarding the stability of magnets.

Permanent magnets properly made and applied are very reliable and may be applied with confidence to well-engineered applications.

GENERAL FUNCTIONS WHICH MAGNETS CAN SERVE

In the past, permanent magnets have been used largely for the purpose of providing magnetic fields. This use has been in connection with electrical applications such as field and damp-

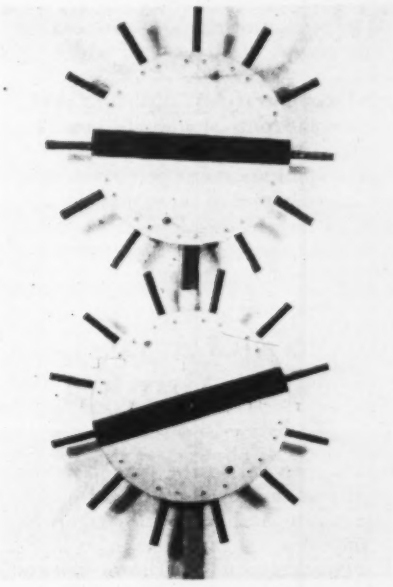

FIG. 3 MAGNETIC GEAR

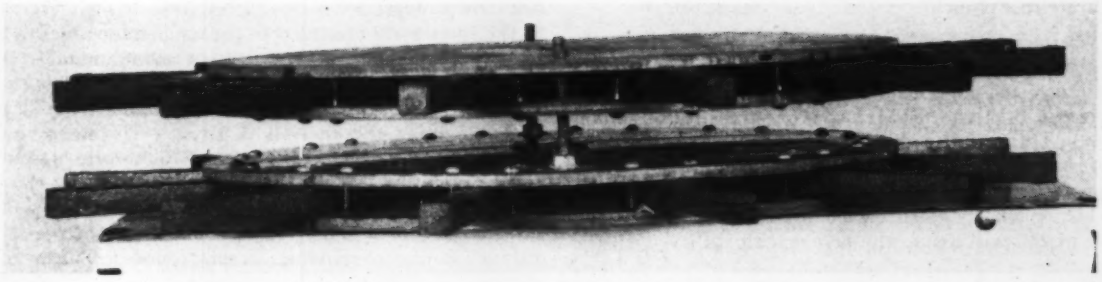

FIG. 4 MAGNETIC GEARS SUSPENDED ONE ABOVE THE OTHER

ing magnets for electrical measuring instruments and meters, and for loud-speaker fields for radio receivers.

The great increase in energy per unit weight has opened up further applications which have always been possible but in large measure have been impractical. The general groups under which magnets may be classified as to application are field magnets; braking, drag, or damping magnets; motion-transmitting magnets; holding, lifting, or pulling magnets.

While it is not the purpose of this paper to treat with applications, at least one example is worth mentioning. Fig. 3 shows a magnetic gear made from bars of Alnico V so magnetized that similar poles are concentrated at the tips. The gears drive by repulsion and move uniformly. Such a gear could be made using standard tooth shapes. For sudden application of load, it would contact and run as a normal gear, but upon return to a uniform load condition it would revert to the non-contacting condition.[5]

A number of applications are being made of magnets to drive through sealed diaphragms to transmit the torques necessary to operate valves or perform other functions. Some of these applications require torques running in hundreds of pound-feet.

Many mechanical functions can be performed by magnetic force of which this gear is but one. The two gears, for example, will react to suspend one above the other if a guide pin is provided for lateral stability, Fig. 4.

CONCLUSIONS

The available permanent-magnet materials have been reviewed and the groups of alloys into which they fall have been discussed.

Some general considerations regarding permanency have been discussed and the conclusion reached that magnets can be made very stable with respect to time.

One interesting application of a permanent magnet to a gear drive has been demonstrated to show that the use of permanent magnets has been definitely broadened by the new high-energy-value materials and that the use of magnets to do mechanical jobs can be expected to increase.

[5] "Magnet Gearing," by H. T. Faus, U. S. Patent No. 2,243,555, May 27, 1941.

Unappreciated Advantages of Modern Gray Iron

(*Continued from page 670*)

properties which are vital to the part in question. For example, a strength specification alone is inadequate, since usually wear resistance, machinability, pressure tightness, modulus of elasticity, or improved toughness may also be needed. With gray iron the engineer must rely on the integrity of the foundry producing his castings. This, however, is no different from what is conventionally practiced in buying pumps, machines, or other fabricated equipment. A few examples, as follows, will illustrate this point:

1 A wet liner of a high-duty Diesel engine would require 18,000,000 psi modulus of elasticity, 1400 lb test pressure, good wear resistance, and good machinability.

Looking at Table 1, the ASTM class 55 or 60 tensile iron should be selected. This iron also offers excellent density to secure the needed pressure tightness. The wear resistance will be of a high order if the microstructure is AFA Type A graphite with the metal being wholly pearlite with no free ferrite. A Brinell maximum of 280 will assure the best machinability with the specified strength. The foundry will be required to use an alloy iron to meet these properties.

2 A high-duty bearing requires 110,000 psi compression strength, good wear properties, and good machinability. The strength is met by a class 35 iron. Because of resistance to wear, a minimum of 200 Bhn should be stipulated, along with a microstructure of AFA Type A graphite, and a completely pearlitic metal background. To assure of the best machinability, a maximum of 230 Bhn should be stipulated.

3 A brake drum or dry-clutch plate requires resistance to wear, heat checking, and thermal stresses with moderate strength, 35,000 psi. The specification should be class 35 iron, with high total carbon to assure of plenty of graphite for resistance to heat checking and absorption of thermal stresses. Specify 3.40 per cent minimum total carbon, with the Brinell hardness at 200–240, no carbides in the metal.

An engineer does well to cultivate close relationships with the casting producer, who can show many short cuts in design to reduce costs and to assure of casting soundness. Indeed, that foundryman who is acquainted with the demands of a casting can more easily meet these demands. He can develop, with the customer engineer, mutually satisfactory tests for the parts to be made. When heavy-duty machines are to be bought, we often consult with and rely on the recommendations of the producer of such equipment. The good foundryman is in the same category and can be of great help in cooperating with the customer in meeting the demands for particular castings.

Atomic Energy Levels

AN extensive research program is under way at the National Bureau of Standards to make a complete and up-to-date compilation of the energy levels of the elements as derived from observations of atomic spectra. The data, which will include all information on atomic-energy levels accumulated in the past fifteen years, as well as previously available material, are being published in pamphlet form by the Bureau. As each major portion of the work is completed, these pamphlets will be assembled into volumes of about 500 pages as Circular No. 467 of the National Bureau of Standards. Section 1 of this circular, Hydrogen Through Fluorine, which covers 45 spectra, has been made available to scientists in related fields and may be purchased from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at 50 cents a copy.

Atomic-energy levels of 231 spectra of 69 elements were all that had been analyzed up to 1932. Today this number is said to exceed 460, representing 82 elements, while the number of known energy levels is greater by a factor of perhaps 4 or 5; yet no complete summary of these data exists. The National Bureau of Standards is meeting this need by the critically evaluated compilation of all energy levels (exclusive of hyperfine structure ascribed to atomic nuclei).

The spectra are presented in the circular in order of increasing atomic number. Under a given atomic number they are listed in order of increasing stages of ionization, i.e., HeI HeII, LiI, LiII, LiIII. For each spectrum a selected bibliography covering the analysis is given. The energy levels are tabulated in the related groups which form spectroscopic terms, counting upward from the lowest. In the tables electron configurations are also given, together with term designations in a uniform notation, term intervals, and g values (magnetic splitting factors found from the observed Zeeman effect). To facilitate cross reference, the author's term notation is also included when necessary.

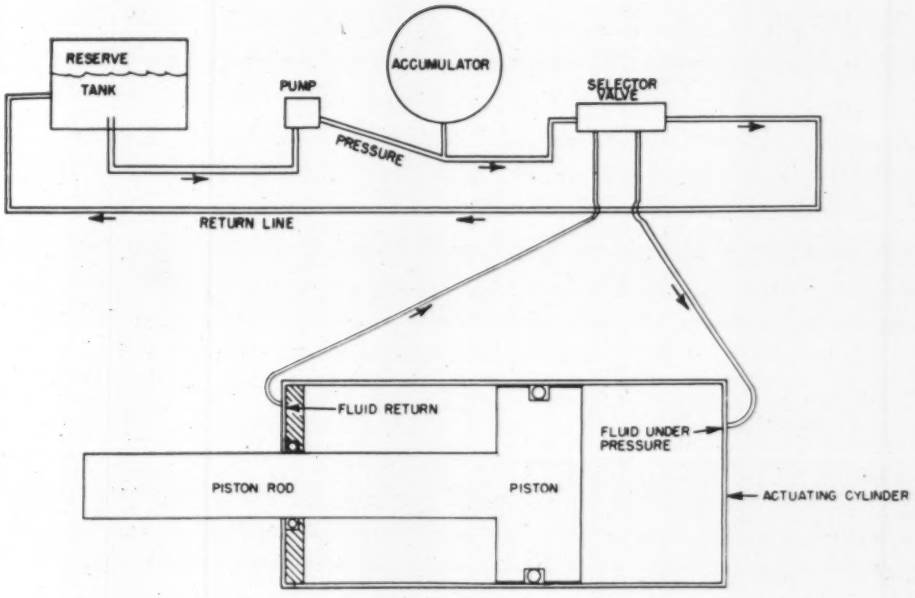

FIG. 1 A SIMPLE AIRCRAFT HYDRAULIC SYSTEM

AIRCRAFT HYDRAULIC PACKINGS

Factors Influencing Their Performance

By LaVERNE E. CHEYNEY and T. J. McCUISTION

BATTELLE MEMORIAL INSTITUTE, COLUMBUS, OHIO

INTRODUCTION

MODERN aircraft employ hydraulic systems for the transmission of power, actuating landing gears, cowl flaps, steering controls, bomb-bay doors, and many other things. There are pneumatic and electrical methods of actuating various moving parts, but hydraulic systems have been chosen especially for heavy aircraft, primarily because of their design versatility, relatively low cost, dependability, and a very considerable saving in weight.

Basically, hydraulic systems are composed of a combination of certain solids, a fluid, and packing or sealing glands, which are intermediate in properties between solid and fluid. Rubber, commonly employed for this purpose, has properties of both solids and fluids. The true solids in the system are represented by a variety of alloys which are fabricated into various structures such as pistons, pumps, cylinders, and so forth. The fluid is normally a low-viscosity lubricating liquid which has as nearly as possible a relatively level viscosity-index curve, in order to facilitate operation of the system over a wide range of temperatures.

The sealing or packing materials currently used are the typical oil-resistant types of synthetic rubber. These rubbers tend to flow in a manner similar to fluids under extremely high pressures such as those found in hydraulic systems, but they exert considerable resistance to such flow at the same time. They are essentially very high-viscosity liquids in their behavior under that particular condition. The amount of resistance naturally depends upon the composition of the rubber, that is, the method of compounding and curing, as well as the formed shape of the object. Within some limits, at least when the distorting pressure is removed, rubber tends to resume its original shape. This is not only an advantage but an absolute necessity in the hydraulic system. The rubber packings, which represent an extremely minute portion of the total volume or weight of the hydraulic systems, do an exceptionally fine job of sealing under a wide variety of conditions. A few failures of such packings do occur, however, and there is some evidence that the causes of such failures fall into certain general classifications. These causes will be discussed later. The performance of the rubber packing determines the performance of the entire system, as any type of failure of this packing may result in failure of parts of the system to operate (emergency systems are included in the aircraft to provide for such situations).

MECHANICAL PERFORMANCE OF HYDRAULIC PACKINGS

Effect of Packing Design. Various types of packing designs have been employed. These have employed other materials in addition to rubbers. It is understood that metal seals are now being developed for use in units such as booster controls where it is desirable to have a very low friction involved in the movement of the packing. Leakage in such systems is almost inevitable. It is usually caught by a so-called U-cup packing and piped through the oil return line so that the over-all net leakage is essentially zero. These metal seals are of two general types: (1) the two-ring type which consists of a good

Contributed by the Rubber and Plastics Division and presented at the Semi-Annual Meeting, Chicago, Ill., June 16-19, 1947, of The American Society of Mechanical Engineers.

bearing metal with a steel expander ring underneath to keep it in contact with the moving surface, (2) the single-ring type which consists of a relatively good bearing metal with enough spring to maintain its own contact with the moving surface. In the very high-pressure system (3000 psi), the moving surface is normally steel. Inasmuch as these metal seals allow constant leakage, which therefore has to be taken care of by some type of relatively complex return system, their use to date has been very limited, and we might safely anticipate that it would remain so in the future.

The V-ring packings were used extensively in aircraft until the beginning of World War II. These rings were relatively satisfactory in low-pressure systems employing fluid pressures of 1500 psi or less. However, they were relatively bulky and

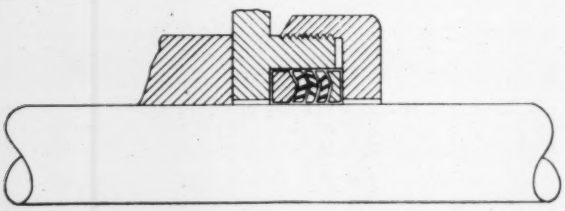

FIG. 2 V-RING PACKING GLAND

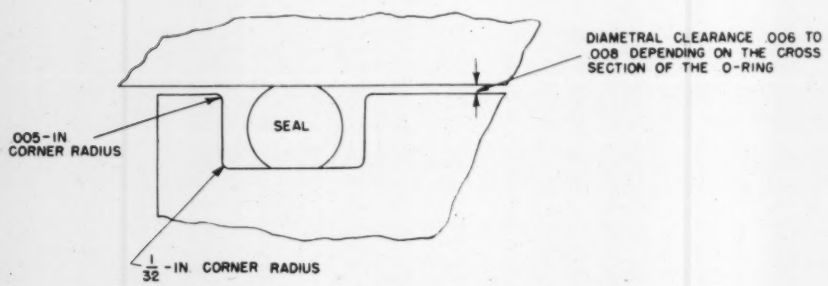
DIAMETRAL CLEARANCE .006 TO .008 DEPENDING ON THE CROSS SECTION OF THE O-RING
SEAL
.005-IN CORNER RADIUS
1/32-IN. CORNER RADIUS

FIG. 3 O-RING AND O-RING GROOVE

Effect of Packing Cross Section. The optimum cross section of an O-ring in relation to its diameter has not been determined. In most cases, it seems to make little difference as long as the packing is sufficiently resilient to withstand the applied squeeze and to maintain contact with the moving surface and the bottom of the groove. One theory has been proposed that the cross section of the O-ring should be relatively large in proportion to the internal diameter of the ring, in order that it might more adequately resist twisting. Twisting, combined with other factors, sometimes causes a type of failure known as "spiral" failure. There is some recent indication, however, that the smaller-cross-section packings do not twist so readily as larger ones. Although this trend, if proved, would tend to simplify the selection of packing cross section, there are still variables to be taken into consideration, and the problem can by no means be considered solved at that point. Any single change in another variable might indicate the selection of a packing of a somewhat different cross section. The military services for reasons of convenience and to avoid complexity have standardized on certain groove and O-ring sizes in specifications AN-P-74 and AN-P-79. The range of sizes represented in the specifications seems adequate for all present aircraft applications.

Effect of Groove Design. In general, a 90-deg groove with a ± 5-deg tolerance, Fig. 4, is relatively standard in most cases for a so-called "running seal." Accordingly, most of the discussion will be concerned with this type. The so-called "slanting-side" groove tends to allow extrusion, whereas an undercut groove, which is satisfactory in preventing extrusion and reducing friction, is expensive to make. The outside corner of the groove must be machined slightly in order to prevent cutting the packing during installation. This is illustrated in Fig. 3

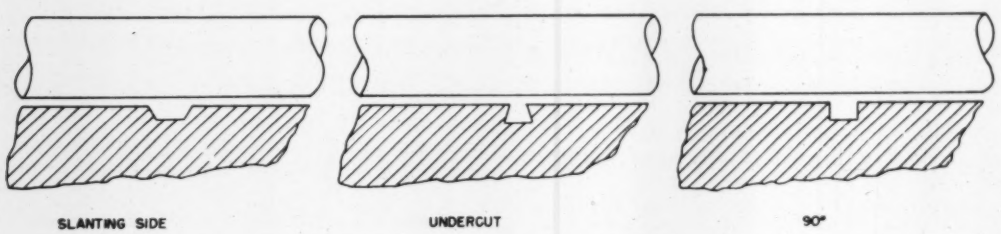

FIG. 4 TYPES OF O-RING GROOVE DESIGNS

expensive as the required units were made up of several machined parts, Fig. 2.

The V-rings were replaced in most new designs with so-called O-rings which reduced costs because of ease of installation and simplicity of design. It is obvious, Fig. 3, that about all that is necessary for an O-ring installation is a simple groove of the proper dimensions for the ring to fit. The O-ring has been used in a wide variety of industrial applications. Subsequent comments will be confined largely to packings employed in aircraft hydraulic systems and almost exclusively to O-rings. Each packing has certain advantages and disadvantages, and a selection of a packing for a given use depends upon the proper balance of all these factors. Other industrial or commercial applications employ packings of varied designs, often consisting of combinations of materials, such as rubber and metal.

Specification AN-P-74 requires a corner radius of 0.005 in. The size of the groove is somewhat important. In general, it should be large enough, that is, wide enough, to allow the O-ring to be fully compressed into it, because the rubber packing can be distorted but cannot be compressed to any significant extent. If the groove is not sufficiently wide, the O-ring will extrude when squeeze is applied and will probably fail because of this. Fig. 5 illustrates the extrusion of an O-ring.

The squeeze applied to the packing is determined by the depth of the groove, and to a lesser extent by the clearance between the two surfaces to be sealed. This squeeze is normally between 0.01 and 0.02 in. The running friction is naturally higher with a greater squeeze, depending upon the composition of the packing or, more specifically, the physical

characteristics of the packing. The breakout friction depends primarily upon the delay before each stroke and the stroke speed for a given rubber composition. However, other factors such as squeeze, surface finish, fluid properties, and the like, may affect the breakout friction to a varying degree.

Effect of Metal Finish. The surface finish of the metal in contact with the packing during motion has been standardized at 5 to 10 microin. A surface "roughness" of less than 5 microin. has been reported to cause spiraling of the O-rings. The results are not particularly consistent, however. Too rough a finish, that is, greater than 10 microin., tends to abrade the packing. Undoubtedly the friction involved in motion against various surface finishes varies, but there are at this time no available data concerning this point. Various types and methods of surface treatment of the metal have been tried with some promising results. Phosphate or similar surface treatments may tend to minimize friction or abrasion by elimination of the more pronounced differences in metal surface finish. The more pronounced differences in metal surface finish may also be reduced by the relatively new technique of "electropolishing." Electroplating has been employed in some cases, primarily to reduce abrasion.

Effect of Corrosion of Metal. The corrosion of the metal surface in contact with the rubber packing in a static seal has been reported to cause a type of seizing or bonding of the packing to the metal surface. It was stated by one aircraft concern that an O-ring had actually been pulled out of its groove in a slide-valve seal by such an effect.

Corrosion tends to pit the metal surface and, conceivably, this could roughen it and cause excessive wear of the packing. Under extreme conditions the packing might later fail by continuance of a tear or cut. Under less extreme conditions, the abrasive wear of the packing might be sufficient to cause leakage.

Most exposed metal surfaces are plated to prevent corrosion. The corrosion of other parts usually occurs in storage rather than in actual operation of the aircraft.

Effect of Diametral Clearance. Many cylinders are subjected to side loads and so-called "breathing," therefore, the maximum clearance must be used when computing clearances

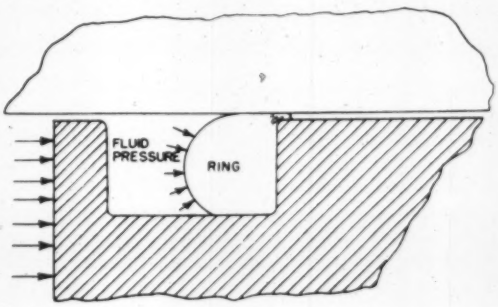

FIG. 5 EXAMPLE OF O-RING EXTRUSION

The packing cross section has some effect, since less extrusion will be obtained with a larger cross section. The influence of this effect is not exactly known.

There is a greater tendency for the packing to extrude as the clearance becomes greater. However, this factor is also dependent upon the modulus of elasticity of the packing and the operating pressure of the system. It must be kept in mind that the unit must be able to operate at zero pressure (that is, in assembly) as well as at high pressures.

Effect of Operating Pressure. There are indications that 200 psi pressure is approximately the critical pressure in so far as leakage is concerned. The systems operating with less than 1500 psi successfully employ all of the various types of packings. The 3000-psi systems use O-rings with so-called "backup rings," usually constructed of leather, Fig. 6. These prevent extrusion of the packing. The tendency toward extrusion is greater as the pressure is increased. The O-ring apparently depends upon resilience and flow under pressure, whereas the V-ring utilizes the pressure under its lip.

It has been reported by the Douglas Aircraft Company that O-rings operate at high pressure with less friction than the V-ring type packing. At high pressure, the V-ring also tends to fail by extrusion.

The T-ring is a relatively new design for either high- or low-pressure operation, Fig. 7. It has a plastic laminated backup ring on either side of the packing itself. This design is supposed to prevent the twisting of the ring. It cannot be used

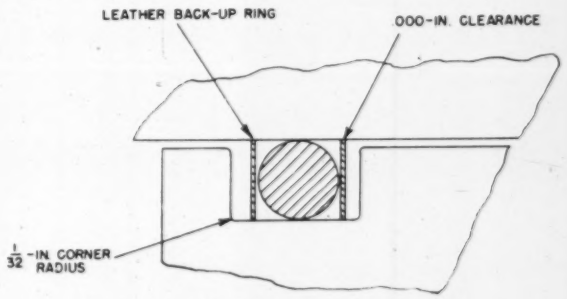

FIG. 6 BACKUP RING INSTALLATION

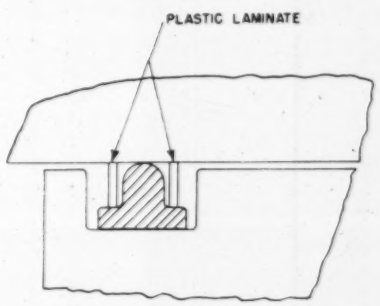

FIG. 7 T-RING PACKING GLAND

interchangeably as a rod seal or piston seal, however, as the top of the T must always be in the groove.

Effect of Temperature. Modern aircraft are required to operate over a very wide range of temperatures, and, consequently, temperature variation of materials and their properties are major factors in design. Hydraulic systems are a prime example. Military operating requirements are somewhat more severe than those for ordinary civilian craft. Temperatures as low as —65 F are specified for military operation at present. Even lower temperatures may be required in future aircraft.

Sufficient flexibility of the rubber packing at these low temperatures is difficult to obtain. It can be achieved by the addition of plasticizers, which to some extent harm the physical characteristics of the rubber at normal temperatures. In addition, they cause complications, because most of the plasticizers are soluble in hydraulic fluids and alter the properties of these fluids after they are leached from the packing composition. As the temperature is lowered, the rubber composition becomes harder, less resilient, and sometimes actually brittle if not properly compounded. The packing may fail to seal because of these physical changes. In addition, the packing may break under some operating conditions.

High-temperature operations, on the other hand, tend to age the packing rapidly and made it temporarily more plastic, so that failure from extrusion or twisting is more likely to occur.

Effect of Aging of Packing. Most of the rubber packings aged in air to a variable degree prior to installation. The amount of such aging depends upon the delay between manufacture and installation. It is well known that the physical characteristics of natural rubber and various synthetic rubbers change upon aging in air. This is caused primarily by oxidation and is usually more severe in sunlight. Compositions containing considerable quantities of plasticizers, such as those which have been employed in hydraulic packings, also may lose plasticizer by evaporation from the surface at a relatively slow rate. Sometimes an additional loss of plasticizer is caused by a so-called "sweating" or exudation, which is a result of incomplete compatibility of the plasticizer with the vulcanized-rubber composition.

In so far as oxidation itself is concerned, the rapidity depends upon the temperature and, as Fig. 8 shows, the effect becomes much more pronounced as the temperature is elevated. The physical effects of such oxidation are gradual loss of strength and hardening of the rubber composition. Loss of plasticizer also results in an apparent hardening, although this is not necessarily accompanied by loss of physical strength.

Aging in fluid, especially at elevated temperature, takes place at a somewhat slower rate, but the general effects are much the same. There is one significant difference, however. The plasticizer is usually extracted from the packing by the fluid and is replaced to some extent by fluid itself which in turn acts as a plastcizer. This extraction takes place very rapidly at first and at a gradually diminishing rate thereafter. The effects of all types of fluids are not necessarily the same.

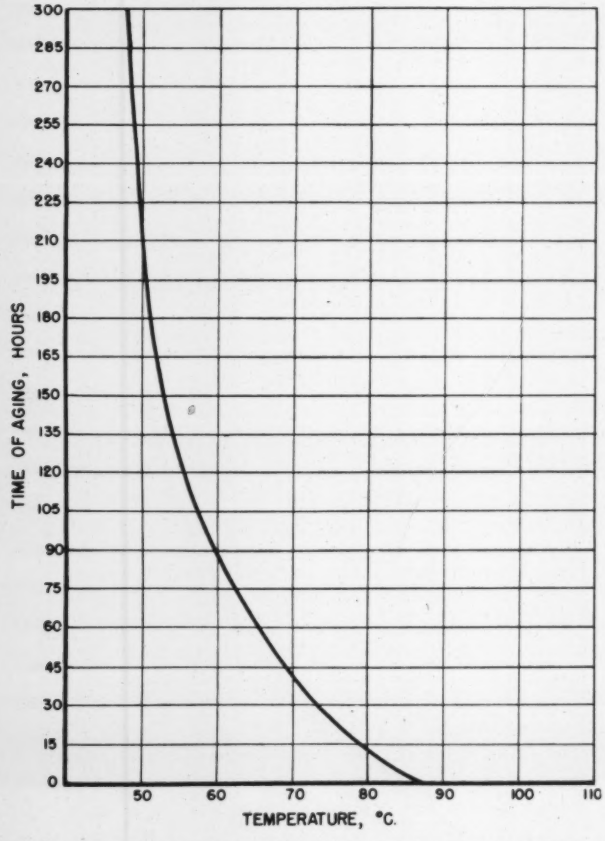

FIG. 8 EFFECT OF TEMPERATURE ON AGING OF A TYPICAL RUBBER COMPOSITION

Some fluids show indications of replacing the plasticizer and substituting for it to a considerable degree, whereas others apparently merely extract the plasticizer and cause a degradation of the physical characteristics of the rubber composition. Another by-product of such extraction is a contamination of the hydraulic fluid by plasticizer, which has been shown by the work of Dr. Fenske and co-workers at the Pennsylvania State College to be very detrimental to the low-temperature characteristics of the hydraulic fluid itself.

There have been some reports that certain commercial plasticizers tend to hydrolyze in contact with water present in the hydraulic fluid. The products of hydrolysis may cause corrosion of metal parts. This effect has not been serious in operating aircraft but has caused much difficulty in storage.

Effect of Swelling Fluid. All types of natural and synthetic rubbers swell to varying degrees in types of fluid employed as aircraft hydraulic fluids. In some cases the amount of swelling is positive and very considerable; in others, there is a net shrinkage, where plasticizer is extracted from the packing composition and is not completely replaced by hydraulic fluid. There have been some indications that certain types of plasticized rubbers swell more than their unplasticized analogues.

The usual effect of swelling in fluid is a decrease in strength. This will vary considerably with the type of rubber and the type of fluid.

The amount of swell in the fluid to be employed must be considered in designing the aircraft hydraulic system. Complications will arise in systems such as landing-gear actuating struts, where a packing may be in continual contact with fluid on one side, and it might be expected to swell and to undergo any other aging changes caused by the fluid. But on the other side, the dry packing is in contact with the atmosphere and will tend to lose plasticizer by evaporation and to oxidize at least on its surface.

Effect of Changes in Properties of Fluid. It is well recognized that fluids as well as packings change their physcial characteristics over a range of temperatures, and that it is impossible to maintain a fluid at exactly the same viscosity over the normal aircraft operating-temperature range. It is outside the scope of the present paper to consider the effects of changes in viscosity of fluids upon their action in pumps and such parts of the hydraulic system. Any variation in properties of the fluid, however, does have an effect upon the performance of the packings.

If the fluid becomes too viscous or freezes at too high a temperature, the effects could be very serious. For example, the brakes might not work with sufficient rapidity on a landing, and at the present high landing speeds, delay of a few seconds might be fatal.

Certain parts of the aircraft hydraulic systems, such as brake expander tubes, contain a large amount of rubber in relation to the actual amount of fluid operating in contact with this rubber. Consequently, the relative amount of plasticizer which can enter the fluid by extraction may be excessive. If this has any noticeable effect upon the properties of the fluid, such things as gelation or pronounced viscosity changes may be the net result.

When the present AN-VVO-366B hydraulic fluid is exposed to warm air, the more volatile constituents evaporate, leaving a somewhat tacky film. This film is almost microscopic since the O-ring normally wipes the rods so clean that the oil film cannot be detected by wiping the rod with the finger immediately thereafter. The film, however, possesses sufficient tackiness to cause the O-ring packing to "seize" the rod. Twisting and "spiral failure" may then occur when the rod moves in contact with the packing. However, this is only one of the contributing factors involved in spiral failure.

EVALUATION OF PACKINGS

Packings for military application are presently required to comply with the rather lengthy and detailed specification AN-P-79. This specification has served its purpose well, but reportedly needs revision in some respects. Undoubtedly, changes will be made when sufficient fundamental data have been accumulated. This particular specification includes a variety of tests, many of them very special ones, which are intended to indicate as nearly as possible the expected performance of the packing in actual operation. This is the only justification for the rather elaborate series of checks now found in this specification.

Of the various tests included in the present specification, it is believed by many that the so-called "endurance cycling test" of 40,000 to 70,000 cycles is the most important part. This is only one of a series of expensive tests. It would be highly desirable if some simpler tests could be devised which would be indicative of the expected performance of a material in the qualification test, which employs large cycling equipment. For example, this cycling-test equipment remains idle for periods as long as 7 days, in order to comply with certain phases of the specification testing procedure.

There is criticism in industry because ASTM tests have not been adapted to meet these particular requirements. Testing according to the present specification requires much specialized equipment. In addition, it requires 21 days to complete a series of tests under the present specification. Some potential packing suppliers have been deterred from entering this particular field of military application because they have felt that the amount of testing required was excessive.

TYPES OF MATERIALS

Most of the so-called rubbers and plastics have been tested for potential application to aircraft hydraulic systems. Some of these have applications in one place or another. For example, a plastic laminate is employed in the design of the T-ring.

Of the various natural and synthetic rubbers which may be employed for most of the packings themselves, natural rubber, GR-S, and GR-I (butyl) are unsuited for use with the present -366B type of hydraulic fluid. This is a hydrocarbon-type fluid, and these rubbers swell excessively in this fluid with resultant loss of physical strength. Neoprene synthetic rubber was employed for most of the early packings and was moderately successful as long as operation at very low temperature was not a requirement. The low-temperature characteristics of the neoprene rubber are not particularly good, and it was replaced by the so-called nitrile-type rubbers, formerly known as Buna N, and also identified under several different trade names, as the low-temperature requirements were extended. Several of the relatively solvent-resistant plastics have been studied for use as packings. These have included nylon, Teflon, vinyl plastics, and others. None of these has proved satisfactory to date. Most of them are thermoplastic materials, which become excessively stiff and brittle when moderately cold and excessively soft when warm.

CONCLUSION

The foregoing discussion has pointed out some of the variables affecting performance of aircraft hydraulic packings. It might seem that performance of such packings would be very limited. As a matter of fact, the opposite is true. O-ring packings have performed satisfactorily under a wide variety of operating conditions, often with many of the variables mentioned under improper control.

A variety of operating data have been accumulated during several years of extensive usage of O-ring packings. Many of the data accumulated during wartime were naturally remedial in character. Peacetime research and development are proceeding along more fundamental lines. It is safe to predict that packings of the future will be even better and will perform even more satisfactorily.

Thunderstorm Chart

A THUNDERSTORM Safe-Speed Chart to enable pilots to fly with a higher degree of safety under thunderstorm conditions has been developed at the U. S. Air Force's All-Weather Flying Center at Clinton County Air Force Base, Wilmington, Ohio.

The Thunderstorm Safe-Speed Chart shows the airspeed limits within which nine types of transport and cargo aircraft can be safely operated during thunderstorms.

The limits of allowable speed for safe operation are clearly outlined in green on the Safe-Speed Chart. At either end of the "safe operating range" a red speed band indicates that the flying speed is unsafe for operation in thunderstorms. Between the red and green is a yellow band marking the marginal area approaching unsafe speeds.

Below the safe minumum speed indicated, the airplane will be moving so slowly as to approach stalling speed. Above the maximum safe speed, increased stress will be placed on the aircraft and may result in disastrous structural failure.

The experiments disclosed the safety limitations for both "average" thunderstorms, in which vertical or near-vertical wind gusts attained a velocity up to 30 fps, and "heavy" thunderstorms, in which gust velocities were recorded between 31 and 43 fps. The latter figure was the strongest gust recorded, and the researchers estimated such a velocity would be experienced on an average of only once each 50,000 flying miles. Normal flight regulations would require all aircraft to be grounded in weather so violent.

During the last two years, the All-Weather Flying Center engaged in 2000 flights in thunderstorms with no major accidents or fatalities, all as a part of the "Thunderstorm Project." These experiments yielded detailed information of conditions in which aircraft might be expected to fly during thunderstorm weather. Principal findings concerned the effects of turbulence, icing, gusts, hail, and lightning.

The Air Force's Northrop P-61 "Black Widow" was the experimental aircraft used during the course of the two-year study. The Black Widow satisfied rigid requirements established for stability and high-altitude performance and carried complete radar equipment. To insure effective research, five P-61's were maintained in a constant state of readiness and flew directly to the scene of thunderstorms detected by radar scopes in lookout stations. The aircraft entered the storms at predetermined altitudes of 6000, 10,000, 15,000, 20,000 and 25,000 ft, thus insuring that the observers would have a complete picture of storm conditions at all altitudes at which military and commercial aircraft might operate.

Specifically designed instruments which calculated every detail of the weather conditions from icing to stress on the body of the aircraft, and including gust velocity and electric content of the outside atmosphere, were turned on before entering the storm. Cameras photographed the instruments at four-second intervals and maintained on film a complete record of the readings, eliminating the possibility of human error in recording the data. Observers recorded the time of entry into the cloud coverage in logs and described the areas of precipitation, turbulence, ice formation, frequency of lightning, and other data required for an analysis of each storm.

BROACH *Requirements for* SPLINE SHAFTS *and* FITTINGS

By HARRY H. GOTBERG

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ALTHOUGH splines have been used as a connecting medium for a great number of years, there still seem to be considerable differences of opinion regarding the advantages of involute splines versus straight-side splines.

Even though the involute spline is gaining in popularity, there are still a great number of straight-side spline applications, not only in machine tools, where this type spline seems to be favored—at least at present—but also in automotive, farm equipment, road-building machinery and the like.

As part of the symposium the object of this paper is to cover broaches and broaching of splines. At the outset, it should be understood that broaching can be used equally well for either type of spline. As a rule, spline broaches are made to individual specifications, and manufacturing processes are similar for either type of spline.

DESIGN CONSIDERATIONS

In designing any type of spline, it should be emphasized that the tools required should always be considered in the actual product design. Product design can sometimes be altered slightly to facilitate tooling without interfering with the functional requirements, thereby insuring a great saving in tooling costs and maintenance.

The new American Involute Spline Standards serve as a good example of this. Its adoption has reduced greatly the number of hobs required to produce the various splines involved. Similarly, even though it is almost mandatory that broaches be "custom" made to conform to individual-part print specifications, a standard spline system also has many tooling advantages as to broaches. These will be pointed out in detail later.

Advanced tool design, together with standardization of cutting tools and of manufacturing facilities have enabled product engineers to improve the design of many component parts of their products to facilitate tooling, reduce costs, and improve quality. It was natural, therefore, that when the specifications for the new American Involute Spline Standards were established the "tooling" factor was considered most thoroughly. As a result, the amount of tooling required, as well as the cost of tooling could be held to a minimum.

Many elements have to be considered in the processing of spline shafts and fittings. In this connection, one example will demonstrate how broach-tool costs can be minimized by adoption of a standardized program.

It should be understood that the cost of a spline broach depends primarily on its diameter and over-all length, although other elements, such as the number of splines and the depth of the splines, also enter in the cost of the broach.

The length of the broaching tool is determined primarily by the depth of the spline to be cut, the length of the part, and the type of material to be broached. From these, product engineers can usually calculate the torque load and other elements of spline strength. Allowing a practical safety factor, this means that the length of the spline part and the depth of spline can easily be held to a safe minimum, reflected automatically in minimum tooling costs without jeopardizing the strength of the component parts.

Since the depth of the spline exerts a major influence on broach length, the new American Involute Spline Standards were based upon a stub tooth form. This tooth form reduces required depth of broach cut, thereby reducing the over-all length of broach, as compared to the length of broach required for a full-depth involute form.

In designing the new standards, another factor influencing broach costs has also been taken into consideration. The corners of splines have a tendency to subject a broach to greater wear and breakdown than does the body of the tooth, especially when it is necessary to hold corners to a sharp point. As a result, where relatively close tolerances have to be held on major diameters, difficulty is sometimes encountered in assembling owing to the breakdown of spline corners, even though the difference may be only a little more than a few thousandths of an inch. This condition sometimes occurs after even relatively few parts have been broached.

In order to avoid this condition, the splines in the new standards have been provided with adequate radii on the top of the splines while the component spline shafts are to be chamfered to correspond to these radii. This provision not only insures facility of assembly of splined parts but also increases broach life materially since a broach tooth with a radius does not break down as readily as one with sharp corners.

Another important tooling factor in favor of the recommended standards for involute splines is the advantage of reducing costs in the processing of broaches for experimental designs of products. It is well known that involute-spline broaches are high-precision tools and accordingly are rather costly to produce. Usually the cost of such broaches for experimental purposes tends to be prohibitive, especially where only two or three experimental parts are required. From past experience, we know that it is almost impossible to locate standard broaches of the exact specifications desired for the experimental purposes in mind. In contrast to this, once these new involute-spline standards have been generally adopted, and the broaching tools for them standardized, it will be possible to secure a broach with the exact specifications desired from some other source already using the same tool in production.

MULTIPLE SPLINE PROCESSING

From the foregoing, it readily will be seen that the same results can be obtained when the straight-side splines are standardized to cover a full range with the same degree of uniformity. Since spline broaching plays such an important part in the manufacture and assembling of various kinds of component parts, it might be advantageous to outline briefly the general method of multiple spline processing.

This procedure involves the following: (1) broach design, (2) processing of production parts, (3) effect of heat generation

Contributed by the Machine Design Division and presented at the Semi-Annual Meeting, Milwaukee, Wis., May 30–June 5, 1948, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

(4) broaching of heat-treated parts, (5) spiral splining, (6) gaging, (7) tolerances, (8) inspection. Let us briefly consider these points in detail.

Broach Design—Tooth Side Relief. In broaching internal splines of considerable depth, pickup or galling on sides of splines is sometimes experienced. To overcome this, broaches, having a spline depth of 0.100 in. or over, are usually relieved on the sides leaving only a portion of spline width to size on tooth depth. This is true in either straight-side or involute-type splines as noted in Fig. 1.

Cutting Action. Since the broach cut is generated from the

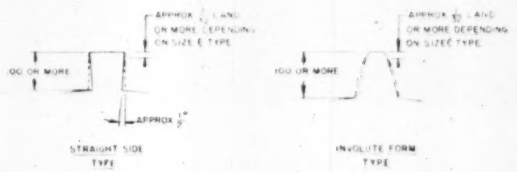

FIG. 1

FIG. 2

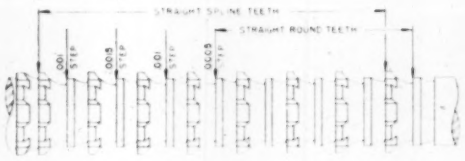

FIG. 3

hole diameter outward by diametrical increments of each successive tooth, as illustrated in Fig. 2, it is not possible to relieve the sides of the splines on depths less than approximately 0.100 in., since it is difficult to reach the shallow depths with a grinding wheel. However, pickup or galling is usually not experienced on such shallow cuts.

PROCESSING PRODUCTION PARTS

In processing parts, the sequence of manufacturing operations is sometimes such that spline arbors are required, so that subsequent machining operations can be performed in relation to spline holes. To eliminate the need of spline arbors, a broach design has been developed which incorporates "alternate round and spline" teeth on the finishing end of the broach. This design, shown in Fig. 3, maintains a high degree of concentricity between the splines and the inside diameter, even though the limits on the finished parts may be as much as 0.010 to 0.020 in. This type of broach thus facilitates the use of plain round arbors for subsequent machining operations. Where it is important to maintain close dimensional limits on the concentricity of inside and outside diameters of the splines, a broach of this design will assist in meeting the specifications.

Every broach, regardless of design or type, has a tendency to "drift" to a certain extent. At times the drift may be very slight, however, and passable parts are produced in the majority of cases. When the limits are held as close as 0.001 in. on both the inside and outside diameters, and these limits are of functional importance in the assembly of component parts, it is advisable to recommend alternate tooth design to eliminate the possibility of drifting beyond the required limits.

EFFECT OF HEAT GENERATION ON PRODUCTION TOLERANCES

Quite frequently it is necessary to produce involute-spline broaches to very close tolerances on the circular tooth thickness, these limits often being held to as little as 0.0005 in. total tooth tolerance. This of course requires extreme care in manufacturing the broach, since a slight accumulated error in broach-tooth spacing, as well as in tooth width, will infringe upon the permissible limits on the tooth thickness.

Sometimes, when a broach is put to work, it will at first produce parts that will permit a "go" gage to enter and "no-go" not to enter. However, after broaching several parts, the heat generated in the broach may become great enough so that a "no-go" gage will enter the parts. It has been thought that the broach could be ground slightly undersize to compensate for expansion due to generated heat, preheating the broach before actually using it, to correct this difficulty. However, in attempting to follow this procedure, it will be found almost impossible to maintain production consistency.

Rather, it is recommended that two passes be used where tolerances are sufficiently close to make heat expansion a problem. Fig. 4 illustrates the method used to perform this func-

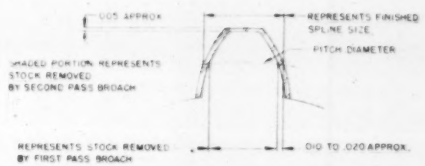

FIG. 4

tion. The first-pass broach should leave approximately 0.010 in. to 0.020 in. on each side of the spline. If parts are permitted to cool between the first and second pass, the heat generated in the second-pass broach is then not sufficient to result in material heat expansion under these conditions.

BROACHING OF HEAT-TREATED PARTS

When parts have to be heat-treated after broaching, a certain amount of distortion usually takes place. To correct this condition after heat-treatment, a sizing broach, which is classed as a "hard-gear" broach, may be used. The name is derived from the fact that these operations are usually required on gears where the teeth on the outside diameter are hardened to "extremely hard" Rockwell readings. It should be understood of course that if the outside gear teeth are to be hardened to more than C-40 Rockwell, the splines must be "painted" or packed to prevent the splines from exceeding that hardness. This facilitates rebroaching. Gears hardened to higher Rockwell readings, it is true, have been successfully rebroached, but the higher the Rockwell the lower the tool life.

SPIRAL SPLINING

Spiral splines of both the straight-side and the involute type are produced in a manner similar to that employed for conventional straight splines, with the exception that it is necessary to incorporate facilities for generating a helix. In producing a splined spiral shaft, the amount of helix angle which can be developed is not limited since hobbing or shaping equipment can be geared to produce even very steep helix angles. In broaches, however, a more difficult problem is presented. In grinding

spiral-spline broaches, master lead screws are used. The master bar is "driven" by horizontal motion in the direction of its longitudinal center line. The helix angle, as a result, is somewhat limited since, on excessive angles, the side thrust becomes too great to rotate the bar. However, satisfactory broaches with a helix angle of approximately 60 deg from the horizontal center line have been produced.

Actual spiral-spline broaching is similarly affected. It is necessary to rotate the broach by mechanical means especially when the helix angle exceeds 15 deg or so. This is usually done by clamping the part rigidly to a face plate on the machine and rotating the broach by means of a helical drive head actuated by a master spiral lead bar.

SPLINE PLUG GAGES—SPLINE RING GAGES

Spline "go" gages are usually designed to allow for clearance on the outside diameter as well as on the hole diameter, since the primary purpose is to check width of the spline and for possible spacing errors.

The spline width on the "go" gage is usually held to the low limit of part specifications with a minus 0.0001-in. tolerance. "No-go" gages are likewise designed to allow for clearance on outside and inside diameters, with the spline width held to the high limit of part print specifications, and a tolerance of plus 0.0001 in. It has been found that holding to these tolerances will allow for maximum tool life on broaching tools. These specifications apply to gages for both straight-side and involute straight splines as well as to spirally broached splines, Fig. 5. The length of the "go" spline plug section should be equal to the length of the part as nearly as possible, to insure that the splined hole will be straight through the entire length of the part.

Spline ring gages for checking straight-side or involute-type splines differ slightly in design, Fig. 6.

Spline ring gages of the straight-side type are of "open-end" construction and can be made to check the outside diameter of the shaft, as well as spline width and spacing error.

The involute-type gage must be either broached or shaped and lapped or ground, depending upon the equipment available, as well as the sizes under consideration. The involute type is designed with clearance for outside and inside diameters of the shaft. However, tolerances on the spline width and circular thickness are the same in either type, as follows: "Go" gage spline width held to high limit of shaft with a plus 0.0001-in. tolerance. "No-go" gage spline width held to low limit of spline shaft with a minus 0.0001-in. tolerance. It will be noted the gaging tolerances as outlined will allow maximum tool life.

However, difficulty is sometimes encountered in determining in which direction gaging tolerances should be allowed; that is, whether the manufacturing tolerances of a spline "no-go" plug gage should be held to the high limits of a part with a plus tolerance or with a minus tolerance; and whether a "go" spline plug gage should be held to the low limits of the part with a minus tolerance or a plus tolerance. Since there is no standard rule as yet governing these conditions, it is almost impossible to maintain consistency of gage design. It is hoped that before long gaging practices will be standardized to allow for "effective" fit, making allowances for manufacturing errors.

TOLERANCES

It has been found, in rare instances, that where very close tolerances on spline width are specified, the customer has actually withheld the total tolerance and specified less tolerance than really allowable in order to be sure that the tools would be well within the accuracy limits required. This procedure does more harm than good, since when an extremely close tolerance is given, the designer as well as the broach grinder is instructed

FIG. 5

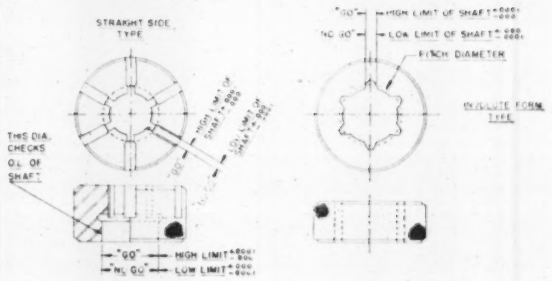

FIG. 6

to hold the spline width as close to the high limit as possible in order that the tool will not cut undersize.

When a tolerance of 0.0005 in. is actually permissible, and instructions are issued that a 0.0003-in. tolerance is to be held, the chances are that the broach will tend to cut oversize, whereas if the entire 0.0005-in. tolerance had been submitted, enough leeway could have been given to assure holding to the correct tolerance as given on the part print specifications.

INSPECTION

Inspection gages frequently differ from the gages used in actual production departments, that is, production gages are held to closer tolerances than inspection gages to allow salvaging of parts not passable by production gages. When this procedure is followed, it is suggested that actual dimensions be submitted to the gage manufacturer rather than master gages "to be copied," since the master gages may vary dimensionally from time to time, making reproduction difficult.

Engineering and the Medical Sciences

(Continued from page 662)

was gained. It revealed however, with startling clarity, how little we really knew about the effect of individual minds on each other and the vagaries of group behavior. Many of us have seen riots, panics, and mass heroism, yet few of us know the spark that often makes men behave in a manner foreign to their nature when acting together. Leader or politician, preacher or rabble rouser, all seem to have something in common in their ability to sway crowds, yet we know little, scientifically, of the force which they use or the reactions they cause.

The engineer is out of his element when it comes to the operation of the human machine, though he is keenly aware that his own developments have become limited by the capability of man himself. He does feel, however, that he can contribute substantially to the medical profession by providing some of the tools to reduce the time and effort in both research and practical work and thus to accelerate progress to his own ultimate benefit.

In the hope of a better world to come, we turn to the medical profession to spearhead the research which will eventually bring mankind to greater knowledge of itself. It is perhaps our only hope in face of the inexorable advance of science.

In Defense of

COMPETITION[1]

By RALPH E. FREEMAN

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

CAN political democracy survive in a country which has adopted comprehensive planning of its economic life? Those who say "yes" usually point to Great Britain, now run by a socialist government which has nationalized important industries. But political democracy is still a reality in Britain. The fundamental rights of the individual—freedom of speech, of the press, and of worship—are still retained. If the British people do not like the type of planning they get, they can throw out the planners.

Those who answer "no" to this question generally cite the example of Soviet Russia. They say that in Great Britain the planning is not comprehensive and is yet in its early stages. As the area of competitive freedom is further curtailed in that country, fundamental rights will gradually disappear. The stage will be reached when those in control of the planning machinery will perpetuate themselves in power by using the weapons of economic coercion.

DEMOCRACY A "COMPLEX OF STANDARDS"

This is essentially the view advanced by David McCord Wright in his new book, "Democracy and Progress."[2] He takes the position that competition in economic life is necessary to the preservation of democracy in political and social life. In fact, he regards democracy not merely as a political condition in which people govern themselves through elected representatives, but as a "complex of standards." It involves, for example, the competitive market which in and of itself is an application of the elective method to economic life.

"Viewed in the large, and with allowance for innumerable shortcomings, the competitive pricing system may be thought of as a perpetual election to decide what shall be produced. Money outlay forms the votes, advertising is the campaign literature, and the election returns—determining what goods shall be made and what not—are profit and loss. By this method we achieve such 'democracy of choice' or of 'preference' as we have secured."

Professor Wright goes on to argue that the competitive system is essential also to material progress. The administration of the complicated industrial machinery of today requires highly trained and skilled men in positions of control, and there must be some method of selecting these men. The competitive market does this work of selection and much more efficiently than it is done under a totalitarian regime. The competitive system also provides incentives to creativeness and improvement, and here again the results are far superior to an organization which relies on seniority as a means of determining the compensation of its creative workers.

In the course of his discussion of democracy and progress Dr. Wright ranges over a wide field. He deals with business cycles, savings, investment, distribution of wealth, taxation, trade unionism, foreign trade, and many other matters of interest to all men and women who are trying to steer their way through the many conflicting theories and programs that are being hotly debated in these confusing times. His book is useful and stimulating, not only because of the many problems discussed, but also because of the thoughtful and critical approach to these problems.

"The true friend of democratic and competitive capitalism does not try to claim for his system a smoothness of performance which is in the nature of things impossible. Such claims may be made with apparent impunity during good times, but they have an unpleasant habit of backfiring later."

The author realizes the difficulties of setting up an economic system that will provide both security and freedom. He frankly admits that in order to stimulate invention and creativeness it is necessary to put up with some instability. A progressive world is likely to be an unstable world. He criticizes the extremists—the conservative as well as the ultraliberal. He believes it possible through the competitive system to work out a satisfactory compromise.

The ultraliberal is open to censure because he would remove the chief incentives operating in competitive capitalism. Such a result would follow from opposition to profits and the advocacy of radical redistribution of wealth as a means of preventing an excessive amount of saving. The conservative, on the other hand, is criticized for his undue tolerance of private monopoly, his support of high tariffs, and his indiscriminate emphasis upon economy in government.

"The conservative policy is boom economics, and the ultraliberal policy is depression economics. . . . The conservative policy emphasizes supply and obstacles to production, while the ultraliberal policy puts all of its emphasis upon demand, and frequently seems to assume that demand will automatically satisfy itself. But, as everyone should recognize, both sides of the case have to be remembered."

AUTHOR PROPOSES MIDWAY POSITION

The author's own proposals represent a midway position. (1) Large government outlays on health and education to provide a reasonable equality of opportunity for all citizens. (2) A combination of social insurance and unemployment benefits to furnish a minimum of security. (3) Expenditures on public works to be undertaken as an offset to a decline in demand for durable goods—such decline being the chief cause of depressions. (4) A program of foreign investments—accompanied by reductions in the tariff—as a means of safeguarding against the possibility of an excess of savings over domestic investment.

These measures, however, will not be effective unless there is self-control and responsibility in the individual. Professor Wright places great emphasis on moral and artistic values and standards. "Not the ending of competitive acquisition should be our goal, but the competitive acquisition of nobler things in a nobler way. Putting the matter in a somewhat Chinese way: betterment comes by inculcating a superior and humane code of 'good manners' of competition."

[1] One of a series of reviews of current economic literature affecting engineering prepared by members of the Department of Economics and Social Science, Massachusetts Institute of Technology, at the request of the Management Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Opinions expressed are those of the reviewer.

[2] The Macmillan, Company New York, N. Y., 1948, pp. 220.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

COMPILED AND EDITED BY J. J. JAKLITSCH, JR.

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context and credit to original sources is given.

Professional Education

ENGINEERING educators contributed heavily to the success of the Inter-Professions Conference on Education for Professional Responsibility, held recently in The Inn, Buck Hill Falls, Pa.

The Conference, a meeting of 96 educators from the five professional fields of law, medicine, divinity, business, and engineering, was sponsored by the Carnegie Corporation of New York to provide an opportunity for the different professions to assist each other by telling of their experiences in the effort to establish educational programs which would graduate not only competent practitioners but good citizens and better men and women as well.

In reading papers, moderating sessions, and in speaking from the floor the representatives from engineering clearly illustrated that their profession was in the forefront in the drive for such programs.

As the first speaker for engineering, President Harry S. Rogers, of Polytechnic Institute of Brooklyn, pointed out and warned against the gaps between the statement and achievement of objectives in the education of the engineer.

After outlining the nature of engineering thought, President Rogers declared that the greatest gap in the achievement of educational objectives stated by the Committees of the ASEE lies in the lack, in both educational and professional groups, of a thorough, critical understanding of this basic and generic philosophy of engineering thought and the failure therefore to integrate the training given in the particular courses of a curriculum, and to lay the foundations of a general philosophy of method which can give a stronger unity to the engineering profession.

ENGINEERS SKEPTICAL OF GENERAL EDUCATION

President Rogers also expressed the view that education for responsible citizenship could not come from general education as we know it today, and that engineers are skeptical of the methods and achievements of general education.

He said that we have listened too long to such trite expressions as the "Liberal arts prepare one for living, whereas specialized training prepares one for making a living." It seems apparent that those who make such statements are confusing the cumulative contributions of liberal culture to mankind with achievements which can be reasonably expected from two years and eight months of general education.

He stated further: To achieve results in the education of students for responsible citizenship will require a more specific determination of the social and philosophical consideration of general education by competent philosophers as well as a more comprehensive and valid development of the theory of mental organization and the structure of personality on the part of psychologists.

In conclusion President Rogers said that there may be strong opposition to departure from a position of neutral scientific detachment within the areas of general education, but should we fail to undertake the correlation of knowledge with the conditioning of attitudes and behavior we had better stop prating about preparation for responsible citizenship.

PRINCIPLES OF PROBLEM SOLVING

Prof. B. Richard Teare, head, department of electrical engineering, Carnegie Institute of Technology, stated that problem solving is the main task of the engineer and, when employed in the right way, is one of the most important activities in engineering education. He described how the problem-solving method is being put to use at Carnegie, pointed out the dangers in using this type of instruction, and made suggestions for instruction by problem solving.

He said that the problem-solving madness requires method in teaching. For teaching through the use of problems is not of necessity good education, and, in fact, may be a waste of time, or worse. To be really effective the problems must be directed toward appropriate professional ends, they must be assigned at the right times and in the right backgrounds, and, above all they must be properly handled by the student.

He pointed out that professional education must do more than acquaint the student with facts, principles, and existing procedures; it must, in so far as possible, teach him to use

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources, i.e.: (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

fundamental principles in dealing with situations that are new to him, and also teach him how to continue to learn throughout his life from his professional activity.

After presenting a problem-solving method which included five steps—defining the problem, planning a treatment, executing the plan, checking the work as a whole before using the solution, and learning from experience—Professor Teare said that these stages cannot be considered a rigid sequence to be followed in handling any problem, but without this well-ordered method, exercise in problem solving is little more than exercise in random thinking.

Professor Teare warned against the use of subprofessional problems but added that at times to use professional problems at all is out of place.

For example, in first introducing the student to a new principle such a problem is usually too complex, and probably involves too much detail. What is required is a problem stripped of its complexity and idealized so that the multiple issues are reduced, often to a single one. This is what is meant by an illustrative instance, he said.

Professor Teare also warned against using instances when the student is equipped to deal with the more complex and professionally realistic problem, and against cheating on the part of the teacher when he discusses his use of the professional problem as well as when he is actually using it.

Pointing out that the problem-solving method of instruction is fundamental and adaptable for training for any of the professions, Professor Teare concluded by suggesting that those who use the method should: (1) Recognize the characteristics of the professional treatment of a problem and use this as the criterion for a professional problem; (2) use professional problems as widely as possible in instruction, with care being taken to insure suitable level and background; (3) use illustrative instances where professional problems are not suitable, as in the introduction of principles and in the student's early work with them, but not otherwise; (4) use subprofessional exercises sparingly if at all; (5) above all, insist that the student, while thinking out the problems for himself, conform to the fundamental stages and functions which he outlined and which are inherent in all well-ordered problem solving.

ENGINEERS AND THE PROBLEMS OF SOCIETY

Elliott Dunlap Smith, Mem. ASME, provost of the Carnegie Institute of Technology, stated that education in the past has unquestionably failed to prepare professional men to assume a place of professional democratic leadership in dealing with the problems of society. He outlined a program which includes the following: (1) A new method of teaching humanistic and social courses and a new content for them; (2) a shortening of the time required for a professional degree by teaching the human and social courses at the same time as the professional courses; (3) joining of general and technical education in common method of instruction and in an interrelation of content.

Speaking from experience as the Provost of a school which for the past decade has been developing a program embodying all three of the foregoing points, Mr. Smith stated that the general education included in the professional programs of American schools has failed to provide a basis for good citizenship because of the following:

1 It has been taught in the traditional academic manner and has done nothing more than create even in the better students only the ability to discuss problems rather than the ability and the sense of responsibility to deal professionally with them.

2 The general and technical programs have been taught in parallel (and have never met) or they have been taught in layers, as in the case of medicine or law, in which a student must complete four years of general education before going on to graduate work.

3 In cases where the student goes on to graduate school after completing his "general" education, the intensity of the training and of the later internship and the hard struggle to get established in the profession washes away any social interest which has been aroused in his undergraduate studies.

4 The teaching of the general and technical courses apart has left the intellectual power and discipline of mind which professional education and experience develop, too strictly narrow and technical in character to be applied to social and human problems.

He said that all this emphasizes the conclusion that the position of professional study, work, and development today is so predominant over all other aspects of life that if professional men are to participate adequately in meeting the problems of society, they must apply their professional attitude and skill to dealing with these problems, and it is the responsibility of education to devise means of equipping them to do so.

In order to provide this type of program, humanistic and social education must make its goal the development in the student of power to utilize knowledge both in learning from experience and in dealing effectively with problems, he said.

In outlining his program, Mr. Smith asked the assembled educators to abandon the teaching of "miscellaneous and ill-remembered data," and to concentrate in general courses on principles and fundamentals and on giving the student the power to recognize and solve the problems he will face in his social and civic life.

Welding Research

THE accelerated use of welding during the war accentuated unsolved problems in the design, fabrication, and industrial use of all kinds of welded structures. Investigations sponsored by the Welding Research Council, a project of the Engineering Foundation, 29 West 39th St., New York, N. Y., will be directed toward helping to solve these problems, according to Dr. A. B. Kinzel, chairman of the Foundation's board.

Long-term research includes studies of weldability, structural steel, weld stresses, resistance welding, and pressure vessels. Studies refer to materials used for bridges, buildings, ships, airplanes, locomotives, railroad cars, automobiles, machinery, and refrigerators.

Dr. Kinzel pointed out that it is increasingly important to know how steels behave under different conditions of strain and thermal cycles. The behavior of structures under dynamic stresses, when made with different steels and tested at different temperatures, is receiving particular consideration.

Research in weldability is being conducted at Lehigh University, Rensselaer Polytechnic Institute, Battelle Memorial Institute, University of California, and Massachusetts Institute of Technology. It will aim to evaluate the ductility of various metals as influenced by the welding process. Studies are also being made into the factors under which various metals become brittle so that practical information will be readily available to designers, especially of welded joints for buildings, bridges, tanks, and ships.

Projects on structural steel were initiated at the suggestion of practicing engineers to provide information needed by them in writing specifications for materials and in designing welded structures more rationally and more economically. Static load tests of heavy box girders are being made at the National Bureau of Standards to determine load capacity, energy absorption, and general behavior of steel at various temperatures.

At Columbia University research workers have finished tests to learn whether residual stresses due to welding could combine with load stresses to cause premature failure under impact, before there was time for stress peaks to be ironed out by plastic deformation. With these tests as a guide, an investigation is now being made of the behavior of various kinds of structural carbon-steel materials in plain or welded steel beams at various temperatures, including low winter temperatures.

At M.I.T. a study is being made of the stability of welded compression elements, with the idea of obtaining basic data which can be used in codes to specify optimum and minimum spacings for lengths of welds and proportions of welded elements, in order to insure stability of the structure.

In an effort to evaluate the true load capacity of steel frames and members, an analysis is being made at Lehigh of the plastic as well as the elastic behavior of beams, columns, and connections in rigid frames.

An investigation of the effects of peening will be carried out at the American Bureau of Shipping Research Laboratories. Its purpose will be to establish or disprove the necessity for certain peening requirements, such as elimination of peening of the last layer, in welding codes applicable to field-erected structures like tanks, bridges, and ships.

Aspects of resistance welding are being investigated at Rensselaer, Johns Hopkins University, and the École Polytechnique, Montreal. Studies include projection welding, contact resistance and fatigue strength, and spot welding of mild steel aimed at establishing optimum welding conditions for heavier gages of this steel.

Pressure-vessel research carried on at Purdue and Lehigh Universities is designed to develop information and data which will lead to better, safer, and more economically constructed pressure vessels and boiler drums. Materials suppliers, manufacturers, and users of pressure vessels, insurance companies, and several government branches are co-operating in research.

Track-Tread Landing Gear

A FAIRCHILD Packet equipped with a track-tread landing gear, designed and built by the Fairchild Aircraft Division for the United States Air Force, was publicly demonstrated recently at New York International Airport, Idlewild, N. Y. Grossing 54,000 lb, the C-82 is said to be the first aircraft of its size equipped with the track gear and the first aircraft of any type to have a complete tricycle installation. The twin-engine cargo transport was chosen for the test installation because it was originally designed to operate in and out of short unimproved airstrips when providing air lift for military operations.

FIG. 1 C-82 TRANSPORT EQUIPPED WITH TRICYCLE TRACK-TREAD LANDING GEAR

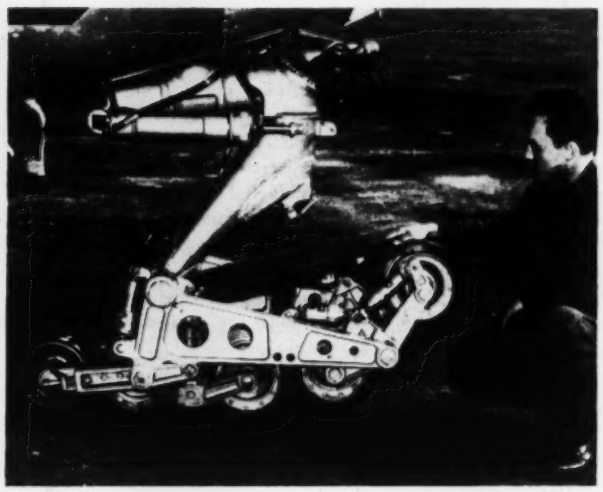

FIG. 2 CLOSE-UP VIEW OF TRACK-TREAD LANDING GEAR

The track gear performs the same function as the beltlike tread on a half track or tank, thus spreading the weight of the aircraft and increasing braking action. Bombers now handicapped by limited landing facilities could land in short distances on rolled-wire mesh laid on turf or sand with a track-gear, since the broad-surfaced track reduces ground pressure to one third that encountered with standard wheel-type gear.

The C-82 installation reduces the pressure from 60 to 20 psi. Both the 14-in-wide ribbed track on the steerable nose gear and the 19-in-wide tracks on each main gear were designed by Firestone Tire & Rubber Company. They are single-piece belts made of rubber and reinforced with a matrix of steel cables. Actual weight of the track gear exceeds the C-82 wheel installation by 275 lb for the nose and 400 lb for each main gear. All three are completely retractable in the same manner as conventional wheel-type landing gear.

According to the Air Forces, track-tread landing gear for aircraft may have an important influence on future military air tactics. Landing strips and forward landing areas for cargo planes and tactical aircraft with track-treads can be built on any reasonably level area. Light construction equipment and surfacing materials may be parachute-landed for preparation of such strips, enabling track-tread transports to bring in heavier equipment for construction of tactical airfields.

Parasite Jet Fighter

THE McDonnell XF-85, Air Force parasite jet fighter made by the McDonnell Aircraft Corporation, St. Louis, Mo., is scheduled to undergo ground and wind-tunnel tests.

The XF-85 has no wheels of its own, and was "rolled out" on a specially constructed dolly. It will be based on a large plane and take-off and land while in mid-air.

Although the XF-85 is designed to be launched from the bomb bay of a B-36, the first flight will be made from a modified B-29.

Design problems were unusually difficult and numerous. As a B-36 bomb bay is only 16 ft long, the parasite fighter was limited to a length of 15 ft over-all. The wing span is 21 ft.

The wings of the XF-85 had to fold completely within the narrow space available and had to extend in the airstream below a plane averaging 300 mph at 40,000 ft. To avoid folding the tail as well as the wings a unique arrangement of the tail—the "X" configuration—had to be developed.

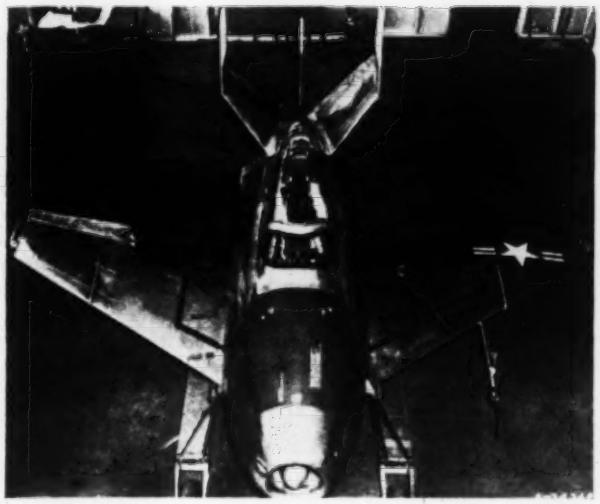

FIG. 3 TOP VIEW OF XF-85 PARASITE JET FIGHTER

was necessary to compress all the equipment of a standard fighter into the stubby fuselage of the parasite. The airplane then had to be fitted to a mechanism which would effectively "hangar" and launch it as necessary.

The parent airplane fulfills the same function as an aircraft tender in flight aerial operations and gives new meaning to long-range bomber striking forces. Not only will the XF-85 parasite refuel while stowed in the bomb bay of the mother airplane, but it will also receive servicing such as radio and radar repair, replenishment of oxygen and ammunition, and limited mechanical repair. Provision is also made for jettisoning the airplane in an emergency after the pilot is hauled aboard.

A high-altitude intercepter with speeds comparable to other jet fighter aircraft, the XF-85 is powered by a single Westinghouse J-34 turbojet, axial-flow engine, capable of a 3000-lb thrust.

FIG. 4 SIDE VIEW OF XF-85 PARASITE JET FIGHTER

As this fighter is designed to operate at extreme altitudes, considerable thought was given to pilot safety and comfort. The pilot is furnished with a heated flying suit, a bailout oxygen bottle, and a high-speed or ribbon-type parachute.

Lightweight Airplane

A NEW and strikingly unorthodox airplane, named the *Satellite*, has been developed and constructed by the Planet Company, according to The Society of British Aircraft Constructors, Ltd. It is a four-seat, light airplane with the engine in the middle of the fuselage driving a propeller located aft of the tail. The airframe is made of magnesium alloy and embodies a novel method of construction.

The fuselage is reported to be a smooth and beautifully shaped

FIG. 5 FOUR-SEAT MAGNESIUM LIGHTWEIGHT AIRPLANE

shell with the cabin in the nose, a 250-hp Gipsy Queen engine enclosed behind the cabin, and a shaft drive to the pusher propeller at the extreme tail.

It is said that the position of the engine and propeller will greatly reduce the noise level in the cabin, as well as insuring a smooth flow of air over much of the airplane's surface.

The company has chosen a new constructional material and evolved a new method of airframe construction. By the use of suitable thicknesses of magnesium, the main stresses are taken by the skin, thus eliminating the necessity for internal strengthening members.

Estimated performance figures indicate a maximum speed of 210 mph, a cruising speed of about 191 mph, and a landing speed of 54 mph.

Gas-Oil Heating Unit

AUTOMATIC domestic-heating equipment, which utilizes natural gas during mild weather and switches to fuel oil in severely cold weather, is reported to have been perfected by the Midwest Research Institute on a research project sponsored by The Gas Service Company of Kansas City, Mo.

The complexity of the project required extensive development work before models were perfected and put into use during the past season. Twenty-five units were installed in private homes and, with only minor adjustments, the performance of all units was reported to be excellent. Based upon the tests obtained with the original installations, 10 to 25 per cent oil in the total fuel requirements will relieve both the severe gas shortage during cold waves and the peak delivery problems imposed on the oil companies and their distributors.

The Institute's engineers report that the efficiency of the new

gas-oil unit has been carefully tested and has been found to be equal to that of existing oil and gas units manufactured separately. Gas is burned in a conventional manner, but a new and different oil burner has been developed which is built into and around the gas system so that many parts are interchangeable. Parts performing one service in the gas cycle will also perform a service in the oil cycle, thereby eliminating a great many parts which would be required if a separate gas burner and oil burner were required in the same furnace. The equipment is not a gas burner and an oil burner, but consists of a single unit designed to burn both fuels.

The Institute's development work on the oil burner has resulted in an extremely simple method of vaporizing the oil, a method in which the oil flows into a shallow pan where it is heated and evaporated by a small gas flame. The vaporized oil mixes easily and well with air to give a good combustible mixture which can be burned and controlled efficiently. The amount of gas required to vaporize the oil is negligible compared to the amount of gas required to heat a house, the real heating value coming from the combustion of the vaporized oil. In the event, however, of a complete gas failure the new equipment will still operate efficiently.

Attempts to obtain a combustible mixture by vaporizing oil with heat and then mixing it with air have been made many times, but it is said that the present development has resulted in the first really practical, low-cost, self-cleaning, and odorless burner.

Operation is entirely automatic. The consumer merely fills his oil tank during the summer months with about 275 gal of fuel oil. The burner is lighted in the fall and all that remains for the consumer to do is to adjust his room thermostat to the desired temperature. An outside thermostat switches over from gas fuel to oil fuel at a predetermined temperature and automatically switches back again to gas as soon as the weather has moderated. The user is protected against any possible low-pressure period resulting from a short gas supply and the pipeline system is relieved of a serious peak-load problem during cold waves, making an ideal fuel combination for both consumer and gas supplier.

Model Testing

THE same principle of small model testing which is successfully applied now to boats and ships may soon be used to study the movement of motor vehicles over various types of soil. The Ordnance Department of the U. S. Army has extended a contract with the Experimental Towing Tank of Stevens Institute of Technology to determine whether scale models can be used successfully to predict operation of full-sized motor vehicles, and to develop methods and techniques for applying such test data to full-scale vehicles.

Experience in the last war with many types of cars, trucks, tractors, and tanks showed the need for more fundamental information concerning dynamic characteristics to facilitate progress in motor-vehicle design. Motor-vehicle design changes are usually based on experience in the field with full-scale models, and information on what makes a vehicle go or not go on certain soils is still very indefinite. Economy and speed possible with small-scale model tests are also important factors in the program.

At the Towing Tank, tests are being made at present in a test bin, 15 ft long, 18 in. wide, and 10 in. deep, filled with Norfolk sand, and equipped with a dynamometer carriage. The first problem is to determine the relationship of test data obtained from a model of one size to other sizes. First, static tests in the bin are made with plates of elementary shape and then a geometric series of four model wheels (4, 8, 12, and 16 in. in diam) are used for dynamic tests and the data are correlated.

The project is in its initial stage, but results so far indicate that the possibility of developing a successful method of model-vehicle testing is good. Equipment for tests is still being tried out and modified, and the type of soils to be used is under experiment. The use of a synthetic soil which can be varied in size to simulate various soil characteristics, is being considered. Test soil equivalent to loam, sand, and clay will be used in the project as it progresses.

Eventually, tests with different wheel designs will be made and various styles of track on which tractor-type vehicles operate will be studied. Model test data will be checked with results of the full-scale tests which are made now at the full-scale test pits at Aberdeen Proving Ground, Md.

Taylor Report on Germany

THE Department of the Army recently made public a report by Orville J. Taylor, special assistant to the Secretary of the Army, based on findings of his recently completed survey of personnel policies and general conditions in the European Theater.

Mr. Taylor undertook a tour of Germany from Feb. 4 to April 12, 1948, inclusive, to examine personally among other things, miscellaneous criticism regarding security, crime record, immorality, drunkenness, and general demeanor and conduct of the Army of Occupation by various critics, male and female.

Of special interest is an account of the job that the Army of Occupation has done and is doing.

According to the report, from and after VE-Day, no part or remnant of the Nazi government was existent. On the contrary, and wisely so for their own good, every member of the party and soldier in the army denied former connection or association with or sympathy for the Nazi party or any phase of it.

The disappearance of any semblance of government for the nation was accompanied by a complete disappearance of municipal government in the cities, with the result that the entire country floundered without direction or control of any authority other than such as was established by the occupying forces. The physical state of the nation was, without exaggeration, one of destruction, chaos, and confusion such as had never before been inflicted upon a conquered country. Utilities of many cities were heavily damaged. Civilian hospitals were generally nonexistent. The plants of all educational institutions in high and low echelons had been devoted to other uses. All means of transportation throughout the country, from its national railroad and aviation systems to the lowliest jitney, including subway, streetcar, elevated, and bus systems, were either destroyed or out of commission. The bridges on every highway of any importance had been knocked out. Fire and police departments and protection were non existent. Every phase of industrial and business activity, including the Ruhr with its all-important production of coal and steel, was completely demolished and nonoperative. Communication, radio, telephone, and telegraph were completely out of commission. The great power plants and network of power lines were down. The cities and nation at large were a mass of rubble. The populace was without food, fuel, and in many instances, housing. The roads were jammed with thousands of DP's and others, wandering in opposite directions in wild disorder and frantic efforts to reorient themselves. Water supply was destroyed with accompaniment of inadequate, if any, sanitation. It was stated that in certain cities, esp

cially in parts of Berlin, the odor of dead bodies permeated the area for a long period of time.

General coverage of the chaos, confusion, and destruction as were present indicates first, the difficult and almost fantastic conditions under which the Army of Occupation has functioned; and second, and more important, outlines that which the Army has accomplished in bringing about the change from those conditions to the status of relative factors as they exist today.

Many Bailey bridges have been installed throughout the zone and thereby blown-out bridges repaired and use of roads made possible. Transportation and communications are far from normal, or rather from the condition that controlled prior to the war, but at least are in operation and in service. The Germans are housed, reasonable fuel provided, and the people are being fed, and although not with the calories that they should have, at least to such an extent as to preclude any outward sign of starvation. No epidemics have appeared. Adequate hospitalization and medical service is being provided. Colleges and schools have been restored and placed on operative basis. The all-important Ruhr is producing 300,000 tons of coal a day, with production of steel gradually attaining normal. Germany now has a government which is functioning in co-operation and collaboration with the allied forces. The municipalities have set up governments headed by burgomasters in which police, fire, sanitary, food, and other commissioners are heading their respective departments that are serving the cities throughout the zone, and although things are rugged, and dire, and depressing, the comparison of Germany today and Germany of July, 1945, furnishes ample evidence of the day-to-day, week-to-week, month-to-month improvements and correction of conditions and of the gradual restoration, rebuilding, and reconstruction of all phases and factors of German society and economy. All of which in the American zone has been done by and under the supervision of the military government and the Army of Occupation. Special mention should be made of the service rendered by the engineers during the 1947 spring floods, during which bridges that were washed out by flood waters were returned to use, supplies and equipment furnished to prevent destruction of many existing bridges, and erection of a large number of emergency bridges. During the crisis, the engineers used explosives to break up ice jams, placed sandbags, and erected ice breakers around wooden bridge supports, and reinforced innumerable bridges. Again, in the drought of 1947, a great shortage of hydroelectric power ensued. Some 200 power-generator sets were installed to supplement the German electric supply. This action, plus strong conservation measures imposed on the whole German economy, resulted in increased electric energy to critical German industries. In the winter of 1946 the power shortage that resulted by reason of lack of hard fuel for steam-generating plants and the freezing of water supplies for hydroelectric plants was met by the installation by the Army of Occupation of a large number of auxiliary power generators throughout the zone. Because of war damage, German municipal water-supply systems were neither safe nor certain. A zone-wide survey of water-supply facilities was made. Every depot in Europe was checked for available chlorination and water-purification equipment. Necessary supplies and technical assistance resulted in installation of adequate chlorination equipment to meet problems of impure-water conditions.

Throughout the zone, housing and facilities for POWs', civilian internees, political and persecuted persons, and DP infiltrees, together with rehabilitating offices, billets, and all facilities used by allied control authorities and allied Kommandantura, water points, and sawmills, shops, depots, storage areas, railroad facilities, and warehouses for use of Quartermaster, Signal Corps, and American Red Cross, recreation facilities for troops, and hospitals were restored, rehabilitated, or constructed as the given situation might require by the Army of Occupation. In all of its operations, the Army of Occupation was always confronted with the major problem of insufficient man power and inadequate supplies. The problem of man power was met by the utilization by the Army of the staggering total of 41,883 persons from the indigenous personnel from the date of occupancy of Berlin up to and including December of 1946. The greatest problem even today is the constant struggle to produce results without the wherewithal to do so. Heating equipment and certain types of fixtures have always been critical. Most types of supplies have been available at one time or another, but never together to allow continued efficient operation.

The report states that the Army of Occupation is doing a fine job, making due allowance for the abnormal conditions which prevail in Europe today. The incidence of black-marketing as well as of crime, drunkenness, and immorality among American personnel stationed in Europe is extraordinarily low, and no need for any radical change in the treatment of our people stationed there is seen. The suggestion of the employment of investigational and disciplinary techniques and procedures is unsound. It bears a closer resemblance to those employed by the Gestapo and by the perverted Nazi tribunals than to American traditional methods which insist upon fair play and the rights of the individual to be secure against persecution, secret denunciation, and unreasonable searches and molestations. Such proposals are unsound and un-American.

Weaving Machine

A REVOLUTIONARY new weaving machine was recently demonstrated by The Warner & Swasey Company in Cleveland, Ohio. The machine, it is claimed, will produce cloth at 2.66 times the output of conventional looms and is capable of considerably faster operating rates depending on the strength of the yarn being woven.

The machine completely eliminates the bulky wooden shuttle containing a bobbin wound with yarn, and utilizes instead a lightweight steel gripper shuttle which grasps yarn from a large-capacity wound cone and carries it through the warp at high speed. The length of filling yarn thus unwound from the stationary cone is automatically held in the warp by tensioning arms while being cut off from the cone, and the ends are tucked into the selvage.

The shuttle is directed through the warp by intermittent steel guides, and so never touches the warp yarn, thus, it is claimed, doing away with a source of yarn abrasion normally encountered. Completing its high-speed, yarn-carrying journey, the gripper shuttle joins a number of others returning by conveyer below the cloth for a later cycle.

While pick for pick, the loom is not much faster than conventional types now in use, it achieves its greater capacity through its ability to weave cloth 110 in. in width, compared to the usual 36, 40, or 60-in. widths.

Continuous supply of weft yarn in large cones results in sustained production of cloth without constant operator attention to bobbins, and also eliminates preliminary operations presently required in winding yarn on the numerous small bobbins.

The present Warner & Swasey machines represent preproduction models based on the original design of Sulzer Brothers, Winterthur, Switzerland, and are being placed in mills for intensive testing under continuous production conditions, as a final step in the company's development program.

A preliminary step in the Warner & Swasey program initiated

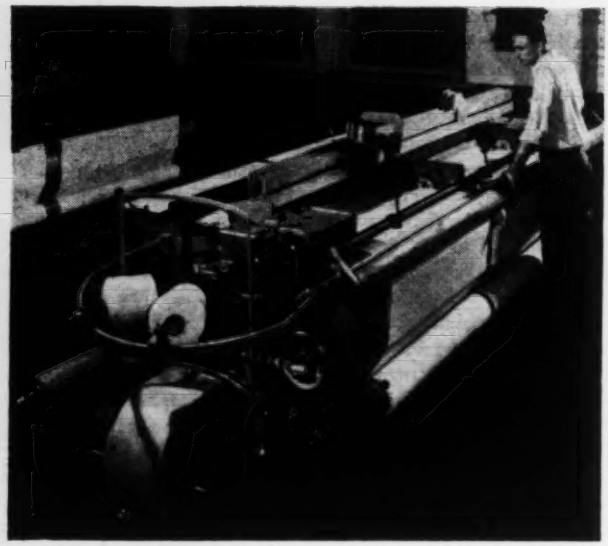

FIG. 6 NEW HIGH-SPEED WEAVING MACHINE

two years ago was the conversion of machine dimensions from metric to English units of measure.

Every component of the Sulzer design was analyzed for redesign for simplification, ease of maintenance, and economy of manufacture. A simple cam which would have required 35 minutes to machine as orginally designed was fabricated in prototype in ten minutes.

With sample machines built and already under test, the final phase of the development program, now under way, is the engineering of tooling and machinery for production lines on which the new weaving machines will be manufactured in volume.

Production models, it is anticipated, will be rolling off assembly lines before the end of the year.

The weaving machine differs from the conventional machine as radically in appearance and construction as it does in performance. It is distinctive in the use of alloy metals, antifriction bearings, and high-accuracy machining; in the complete absence of wooden and leather parts; and in the provision of finely graduated adjustments which, it is reported, make possible a cloth product remarkably free from defects.

Mechanical Manipulator

MECHANICAL "hands," which in dangerous radioactive areas can perform delicate chemical experiments, operate machine tools, and do countless other tasks requiring great dexterity, were demonstrated recently by scientists of the General Electric Company.

The principal part of a device known as a remote-controlled manipulator, the hands also proved they could perform such common jobs as slicing an orange, twirling spaghetti on a spoon, pouring liquids from one receptacle to another, lighting a cigarette, boring a hole, and writing a name.

In actual use the hands would extend over a protective eight-foot-high wall into a radioactive area but would be operated by remote control from a room outside the area, thus insuring against danger to humans from radiation, the scientists said.

The device was demonstrated at the Annual Safety Convention Exposition held in New York, N. Y., by the G-E Research Laboratory and the Atomic Energy Commission. It was developed by John Payne, of the laboratory's Atomic Power Division, which operates the Knolls Atomic Power Laboratory at Schenectady for the Commission.

Impressed with methods used for long-distance manipulation of special tools at the Commission's Hanford Works and the feats performed with artificial hands by an amputee, it occurred to Mr. Payne that similar devices might be used in an all-purpose manipulator.

The actual hands are similar to the double hooks used by amputees. They are at the lower ends of two arms which descend vertically from two horizontal shafts eight feet high across the top of the wall. Vertical arms come down from these at the other ends, and carry at the bottoms the handles with which the operator controls the device. He is seated and views his mechanical hands, eight feet away, with the aid of binoculars and a four-mirror periscope which looks over the wall. His feet are on pedals which control the grasping action of the hands.

The general motion of the hooks corresponds to that given the handles as they are moved up or down, forward or backward, or from side to side. In addition, the handles can be turned around three axes, by wrist movement, and this causes the hooks to do likewise. While most of the connections between handles and hooks are mechanical, the twisting of the wrists is accomplished electrically. This permits the artificial hands to do something real ones cannot. They can be twisted around completely, any number of times, which is particularly useful when unscrewing a nut, for example.

It is also possible, from behind the wall, to change hands. A large one can be used for heavy jobs. If the task requires a more delicate touch, the hand can be lowered into a holder and removed. Then the arm is moved to pick up and attach a smaller hand. Another is provided, instead of hooks, with a pair of snips for cutting sheet metal.

Mr. Payne pointed out that he made every effort to have the motions as natural as possible. Even without practice it is not difficult to do a simple task, such as removing the stopper from a bottle and pouring its contents into another bottle. In the case of operating a drill press, the hands pick the proper-sized drill from the box, insert it in the chuck, place the work in position, turn on the switch, and feed the drill.

In using pedals to close the hands for grasping, Mr. Payne

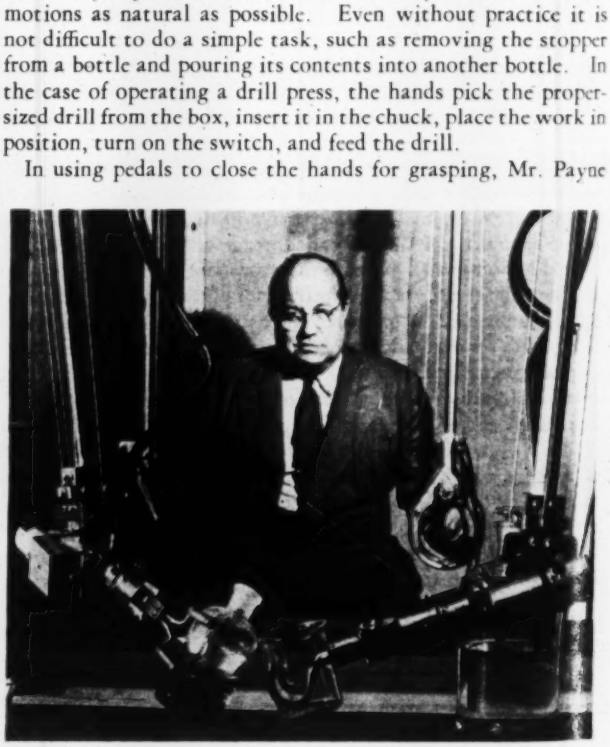

FIG. 7 MECHANICAL HANDS OF REMOTE-CONTROLLED MANIPULATOR IN OPERATION

was guided by the fact that most people are accustomed to the feel of a pedal in operating an automobile brake. The pedals themselves are of regular automobile type, and standard automobile brake fluid and cylinders are used to transmit their force. It is possible to squeeze an object between the hooks much harder than the ordinary person can with his fingers. On the other hand, by a more gentle push on the pedal a very light touch can be exerted so as to break the shell of a hard-boiled egg without damaging the contents.

Gas and Steam Turbo Plant

ACCORDING to the April, 1948, *Engineers' Digest* (British edition), power-plant efficiency can be increased by the combination of a gas and steam cycle and by heat interchange between them in a heat-exchanger in which, for economy and simplicity, the two media are maintained at about equal pressures. An experimental power plant using this principle has been erected at Vitry (Seine) in France. The original article appeared in *Le Genie Civil*, vol. 124, no. 21, November, 1947.

The plant comprises: (*a*) air compressors driven by opposed-piston internal-combustion engines; (*b*) heat recovery and exchange plant for preheating the compressed air and utilizing engine-exhaust heat; (*c*) a pressurized boiler; and (*d*) a turbo unit. Fig. 8 shows a schematic arrangement of the experimental plant. Air is compressed to 1150 psi in three stages, A_1, A_2, A_3, with intercoolers, C and C_1, is heated to 525 C in the heat exchanger K, and then consumed in combustion chambers L, L' of the pressurized boiler I. The combustible gases heat the water tubes N, and superheater tubes O, and are fed into the initial stage of the gas turbine P. Compressor A_0 supplies scavenging air to the internal-combustion engine cylinders B_0 to B_3 at 50 psi, the exhaust gases pass from the cylinders at 600 C, through pipes S into the heat exchanger K, where the compressed air coming from the compressors is heated, and finally enters the gas turbine at a lower pressure stage. With an aerodynamically correct design of tube systems and heat exchanger, these gases should reach the turbine inlet at about 4.5 psi and 320 C.

The lower part of the intercoolers C, C_1 is cooled by a separate cooling-water circuit. Condensate from condenser D, of the steam turbine E, cools the upper part of the intercoolers, is thereby heated to 80 C, then in the turbine feed heaters F and F' up to 150 C, at 70 psi, and thereafter passes through the cooling jackets of the internal-combustion cylinders. Steam is then separated from the water in separator G and superheated to 400 C, in the tubes which completely surround the exhaust pipe system S to form a jacket round the lower part of heat exchanger K. Finally, the steam enters the steam turbine. The remaining water from separator G is passed through the turbine feed heater H, then fed into the boiler water tubes N. The rest of the condensate mixed with the circulation feedwater passes through the cooling jacket Q of the boiler I into the boiler water tubes N. Saturated steam is taken from the boiler drum R at 1150 psi superheated to 550 C in superheater tubes O, and fed into the initial steam turbine stage.

In another scheme, air is compressed in four stages with intercoolers, then burned in a similar pressurized boiler. The burned gases heat the boiler and drive the high-pressure stages of the gas turbine. One portion of the gases then goes through the low-pressure gas-turbine stages to exhaust, and another supplies power to the four expansion stages of a gas-expansion motor-compressor, preferably of the opposed-piston type. Before passing into the last expansion stage, these gases are reheated in one of the compressor intercoolers, and this heat recovery contributes essentially to the over-all efficiency of the plant. Condensate first cools the intercoolers, then passes through feed heaters into the boiler tubes.

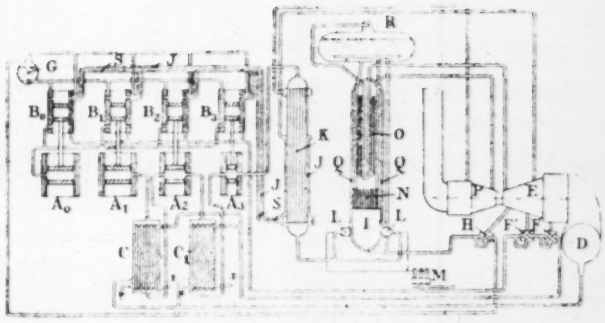

FIG. 8 SCHEMATIC ARRANGEMENT OF COMBINED PLANT WITH INTERNAL-COMBUSTION MOTOR COMPRESSORS

Plants with compressors driven from the turbine shaft are not so advantageous as the plant described, while steam-driven compressors complicate plant construction by the necessary addition of oil separators in the steam cycle.

Electrostatic Accelerator

APPROVAL of construction at the University of California Los Alamos Scientific Laboratory of an electrostatic accelerator designed to yield positive ions with energies up to 12,000,000 electron volts was revealed by Carroll L. Tyler, manager of the Atomic Energy Commission's Office of Santa Fe Directed Operations. This accelerator will be, in so far as is known, the largest and most powerful laboratory research tool of its type in the world. Together with the associated laboratory buildings it will cost approximately $2,000,000 and will take some two years to build.

This electrostatic accelerator will enable the experimenter to change from one kind of ion to another, e.g., from protons to deuterons, with comparative ease. Further, the energies of these particles will be continuously variable from 2,000,000 volts to 12,000,000 volts. By making the proper choice of accelerated particles and of target material, monoenergetic neutron beams of an energy between 30,000 and 30,000,000 electron volts will be available.

The electrostatic generator is widely known as a "Van de Graaf" in recognition of the American physicist now at the Massachusetts Institute of Technology. The so-called "pressurized" version of the Van de Graaf achieved its first marked development and success at the hands of Prof. R. G. Herb, of the University of Wisconsin. It is a pressurized Van de Graaf which is to be constructed at Los Alamos.

Plans for this pressure Van de Graaf were started early in 1946 and the project was first approved in December of that year. Because no such accelerator has been built which operates above approximately 4,000,000 volts, it was necessary to develop the design and to conduct many tests on designs and materials before proceeding with construction. Final approval of actual construction was granted by the Atomic Energy Commission in March, 1948.

A building 120 ft high is proposed to house the accelerator, its associated equipment, and the target setup area. The building site is at the base of a cliff which gives lateral bracing to the tower and serves as a radiation shield for the control room and general laboratory space located near by on top of the mesa.

The generator proper is enclosed in a steel pressure vessel 13.5 ft in diam and 39 ft high, which can be lifted by a 150-ton crane

to expose the vital interior parts for servicing. This vessel will support internal pressures as great as 18 times atmospheric.

The heart of the accelerator is contained in a vertical column 25 ft high, the upper 5 ft being devoted to the production of the ions and the lower 20 ft to their acceleration. This lower section is formed of a stack of 150 steel plates 40 in. diam and separated by insulators. In a rectangular slot within this column and from bottom to top runs a 30-in-wide cotton belt driven at a mile-a-minute speed by a 100-hp motor. Electric charge is sprayed on this belt at the base of the column and is carried to the top where it is removed from the belt. A great potential difference may thus be built up between the upper electrode and the ground. This potential difference will then be used to accelerate charged particles down two evacuated tubes also contained in the column. By means of an electrostatic lens in the upper part of each evacuated tube the ions are focused into a sharp beam just as electrons are focused in an oscilloscope tube. One of these ion beams is used to monitor the energy. The other is bent to the horizontal by means of an electromagnet whence it enters the target room and may be directed toward any of several target assemblies.

The charge transported to the upper electrode would escape in the form of tremendous sparks to the pressure vessel at the relatively low potential of three quarters of a million volts if it were not for the high pressures of gases used and an arrangement of four potential smoothing steel intershells. It is expected that the design will suppress sparks up to an electrode potential of 12,000,000 volts.

A new feature of the electrostatic generator is a pressure-tight "separation" column which encloses the inner column with its belt and accelerating tubes and isolates it from the very high-pressure region. This separation column may be locked to the outside pressure vessel so that the two may be lifted simultaneously. It will thus be unnecessary to release the compressed gas from the large volume of the pressure tank when it is required to service the vital parts of the generator contained in the inner column.

Automotive Gas Turbines

THE extension of the gas turbine to automobiles is discussed in a special article from British Information Services, by G. Geoffrey Smith, editorial director, technical publications, Associated Iliffe Press Limited, London. Mr. Smith is an associate member of the ASME Gas Turbine Power Division.

According to Mr. Smith, two experimental gas-turbine car units were announced almost simultaneously. One of them, the Centrax, which develops 160 hp, appeared unexpectedly as a novel exhibit by Power Jets Limited, on the stand of the Ministry of Supply at the recent British Industries Fair.

The design embodies a second or "power" turbine actuated by the high-velocity exhaust issuing from a comparatively normal turbocompressor unit. This power turbine rotates on a separate shaft and is geared to the driving shaft, rendering the gas turbine a practical possibility for road transport.

The Centrax weighs 250 lb; it is 17 in. in diam and measures 60 in. from the rear-end to the normal car-type starter-motor mounted on the front. The smaller the turbine wheel in a gas turbine the faster it must rotate for a given gas velocity, but small size entails fine clearances.

With a two-stage 6-in-diam turbine wheel the designed speed is 40,000 to 42,000 rpm. With such a speed of rotation, some 12 times faster than a normal car engine, the problem of introducing a suitable reduction gear to the road wheels is not easy to solve. Noise and lubrication difficulties will need to be surmounted during the tests now proceeding. A turbine is not normally designed to run in a reverse direction, so that a simple reverse gear will be necessary. A change-speed gear, however, can be dispensed with, since, being independently mounted, the speed of the power turbine varies with the load. In effect, it constitutes a fluid drive, which is an important function of the separate power turbine.

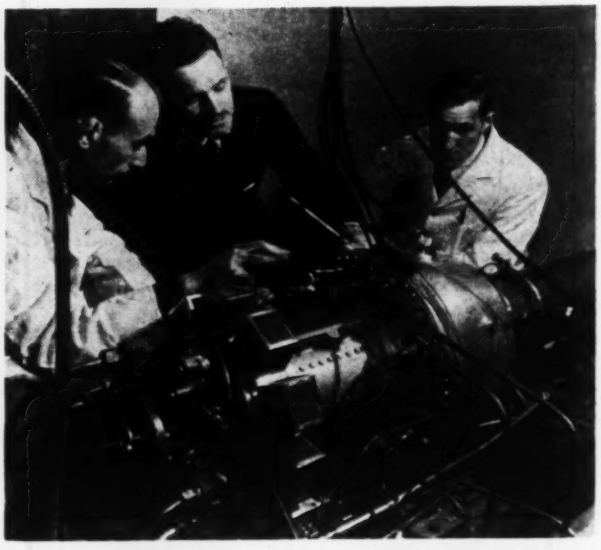

FIG. 9 CENTRAX GAS-TURBINE UNIT FOR AUTOMOTIVE USE

[The new unit, installed in a specially built chassis, is being tested along English roads. The turbocar will run on Diesel oil, without vibration or exhaust fumes, with no radiator, no clutch, and no gear box. Picture shows (*left to right*) Geoffrey White, Richard Barr, and Harry Leach, inventors of the unit.]

The exhibition of the prototype Centrax gas turbine at the British Industries Fair led immediately to the release of particulars of a still smaller turbine with which the Rover Company, Solihull, Birmingham, have been actively experimenting for a long period.

Rover technicians from the outset recognized the practical possibilities for road use of an independent power turbine working in conjunction with a turbocompressor unit. In this case the turbine wheel is only 5 in. in diam and, at its normal designed speed of 55,000 rpm, the unit develops 100 hp. A heat exchanger is embodied to reduce fuel consumption. This engine is 36 in. long, 18 in. wide, and 20 in. high. Its compact shape, free of excrescences, renders it readily applicable to a standard car. It was planned as suitable for test in the current series of Rover 12-hp and 16-hp vehicles (United Kingdom tax rating).

Mr. Smith cautions, however, that this should not be taken to imply that a gas-turbine-driven car is likely to be offered for sale in the near future. A great deal of experimental work is necessary before the power unit emerges from its bench tests. After that, a period of years may elapse before its over-all efficiency and suitability for road use can be judged. Controllability, noise, and fuel consumption are subjects for special study on bench and road.

At the present time fuel consumption with gas turbines is high; but it is being gradually improved by the incorporation of such features as heat exchangers and alloy steels able to withstand temperatures in the region of 650 to 700 C without excessive creep, scaling, or corrosion. Although the present rate of consumption is high, fuel cheaper than gasoline (such as kerosene or Diesel oil) can be used successfully.

The hiss of air passing through a compressor unit at pre-

nomenal speed can be a nuisance, as those acquainted with jet-propelled aircraft well know; but means will be found to silence it, and also to exclude dust particles and foreign matter. This problem of air filtering is a matter for special study in a road unit.

Television

THE technical future of television is now reasonably well understood, according to the *Industrial Bulletin* of Arthur D. Little, Inc. It is stated that the prognosis, assuming peaceful development, is for gradual improvement in reception quality during the next five to ten years up to the level of home movies showing commercial prints. By this time, or even sooner, theaters will offer special higher-quality reproduction, like professional movies; small neighborhood and apartment-house theaters may develop. Between 1955 and 1960 a color system will probably be added.

In March of 1948, television broadcasts were available to more than 30 million people in the United States, through 19 stations. Construction permits have been granted for 64 new stations which will extend television to all the major population centers and a great many secondary ones. Applications have been filed with the Federal Communications Commission for 120 additional stations. The wave lengths assigned to commercial television by the FCC permit a maximum of seven stations in each area. Since television cannot be received much beyond the horizon visible from the transmitter, widely separated stations can occupy the same wave length without interference. Boston and New York are considered distant enough to share the same band, but Philadelphia and New York are not.

Public response has been as enthusiastic for television as it was for early radio, according to the article. The retail value of the 175,000 television receivers made in 1947 was $100 million, compared with $900 million for radio receivers. Production is currently at the rate of 430,000 a year, and total output of receivers during 1948 is estimated at 600,000 to 800,000.

Present standardization on a 525-line system sets an upper limit to quality of television reproduction, but there is opportunity for enormous improvement within this limit. According to this standard, a beam of electrons moves horizontally across the viewing tube 525 times to build up the complete picture; more lines would make a better picture ultimately possible. Gradual development of the present system should markedly improve the extent to which the elements of the picture appear at the right time and place, the fidelity of signal reception and contrast within the picture, and should reduce geometric distortion.

Unwanted "noise," as from trolley cars and automobile ignition systems, sometimes appears as scratches and blemishes on the picture and can be suppressed by improved antenna installations which will require further development. "Ghosts" are caused in some locations by reflections of the signal from buildings or hills and arrive after the direct signal. They can generally be exorcised by a special receiving antenna pointed directly at the transmitter. For more than one station the antenna must be made movable by remote control, which is expensive, or the transmitters must all be located approximately in one place.

The largest television picture visible by direct viewing of the cathode-ray tube on which it is originally formed is said to measure about 18 × 13 in. and is available in expensive sets. To increase the size of the cathode-ray tube, and hence the image, would be a difficult and expensive process. The glass tube is evacuated, and must be strong enough to withstand the pressure of surrounding air; the problem becomes greater as the tube size increases. At present the tube is the most expensive part of a receiver, costing about $130 for a 15-in. glass tube. A corresponding metal tube with a glass front is being introduced this year for about $50. With projection tubes, instead of direct-viewing tubes, pictures are projected onto larger screens, but become somewhat fuzzy in the process. As quality of projected images improves, much larger pictures will probably be made available by this method. For theater and commercial projection, pictures 15 × 20 ft have already been developed.

High-definition systems using more than 525 lines and color have been postponed by the standards decision, but many observers expect that within 10 to 15 years both will be available to the general public. Pictures with a different number of lines could not be received on present sets, but one of the color systems now under development could be received as black-and-white on present receivers with minor modifications. Color receivers will inevitably be more expensive. Broadcasting according to present standards will probably continue, thus keeping present sets in use, regardless of new systems which may be added in the future.

Network programs are now carried between New York and Washington by coaxial cables, which are required for wired transmission of television. Coaxial cable lines have been installed from New York to Chicago and St. Louis, and are expected to be in operation this year. Cables now planned will make national television networks possible within a few years. An alternative method of network transmission uses a series of transmitters located on hills 30 or 40 miles apart. The stations are unattended and beam the relayed program accurately to the next station, with a low power requirement. Choice between these two methods will be on experience with performance and operating cost. Recent developments make network transmission possible without any increase in "noise."

Aircraft Jet Engine

THE U. S. Air Force's J-47A jet engine, designated the TG-190 by the General Electric Company, will be test-flown soon at Muroc, Calif., Air Force Base. It is reported to be America's most powerful production jet engine, with a rated thrust of approximately 5000 lb.

The engine is an advanced development of the company's axial-flow TG-180 (J-35) jet engine.

Although having approximately the same frame size as the TG-180, the TG-190 has many design improvements, a greater thrust rating, and is substantially the same weight as the former unit. Compared with the slightly more than 4000 lb thrust developed by the TG-180, the new engine has 25 per cent more power, according to the Air Force.

Future development of the TG-190 jet, according to engineers, promised to increase its rating to 6000 lb thrust.

First units of the new engine have been undergoing extensive ground tests at the plant. Following completion of the military-required type-testing in the factory, the TG-190 was tested in a North American F-86A single-seat, low-wing fighter with sweptback wings, revealed as having a speed of more than 650 mph.

Altitude and other tests with the new engine also have been under way aboard the B-29 flying laboratory operated by G-E at its Flight Test Center near Schenectady, N. Y. The engine has been installed in the bomb bay of the Boeing Superfortress for flight-testing under altitude conditions. The flying laboratory, operated by G-E engineers and manned by a Pan American crew, also is an Air Force project.

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

Steam Contamination

Turbine-Blade Deposits — Burlington Generating Station, by W. E. Karg, Mem. ASME, Public Service Electric and Gas Company, Newark, N. J. 1948 ASME Semi-Annual Meeting paper No. 48—SA-24 (mimeographed).

Turbine-blade deposits on two 1250-psi 95-F cross-compound turbines became evident immediately after the new equipment went into service in 1940.

Over a period of 7 years' experience with one unit and 4 years' experience with the other, a turbine-blade deposit has been a constant problem to the extent of requiring caustic washing of the turbines of these units on an average of about every ten months. The rate of turbine-blade deposit at first was such that a loss of efficiency expressed in heat rate occurred at about $^1/_2$ per cent per month. Deposit on the last four rows of the high-pressure turbines was found to be water-soluble while that on the first four rows of the low-pressure turbines was found to be almost entirely insoluble silica. Deposit was removed by washing the high-pressure blading with saturated steam and washing the low-pressure blading with caustic-soda solution. Deposits had occurred with silica in the boiler water averaging 5 ppm. A reduction of average silica in the boiler water to 2 ppm resulted in improved conditions with heat-rate increase at a rate of only 0.1 per cent per month. Fortunately caustic washing was quite successful, therefore allowing that the units be kept in service without opening for cleaning. When it was necessary to open the turbines and opportunities for cleaning did occur, blasting with fly ash was very successful.

It appears that a long time was required to make any progress in the solution of the problem. One factor which affected this was the demand for capacity and the need for keeping the units in service, but it is believed that the main handicap has been the inability to measure with sufficient accuracy, by means of station instruments, the purity of the steam coming from the boilers and the inability to detect with sufficient exactness, by means of station instruments, impurities in the condensate going to the boilers. It is believed now that recognition of silica as the main factor in the problem, and the decision to use silica as the basis of analysis of steam and condensate will be the answer.

Reduction of Turbine and Superheater Deposits by Internal Treatment With Magnesium Chloride in the Absence of Phosphate, by F. H. Long and W. A. Pollock, Wisconsin Electric Power Company, Milwaukee, Wis. 1948 ASME Semi-Annual Meeting paper No. 48—SA-26 (mimeographed).

A progress report on the 1340-psi high make-up unit at the Commerce St. Station of the Wisconsin Electric Power Company, gives recent experience with magnesium chloride, which appears to reduce carry-over of sulphate into the superheater in addition to preventing silica on turbine blading.

The installation has a 3-drum bent-tube boiler, having a rated maximum steam output of 375,000 lb per hr, at 1400 psi, and 300 F. The present operating pressure is 1340 psi, and normal steam flow is the full load of 375,000 lb per hr.

Severe turbine-blade-deposit trouble occurred in the early operation of the station. Soluble deposits were caused largely by ingress of carbonaceous zeolite material into the feedwater system. Insoluble deposits were caused by the presence of soluble silica in the boiler water. Severity of the latter prompted removal of silica by internal treatment with magnesium oxide, in the absence of phosphate.

It was found that the substitution of magnesium chloride and caustic soda for magnesium oxide practically eliminated turbine and superheater deposits.

The formation of serpentine (magnesium silicate) chip scale in the boiler imposed frequent scheduled outages for its removal as a precautionary measure against circulation failure.

Supplementary organic treatment also reduced the amount of chip scale.

With present conditions it is possible to run on the basis of 3 outages per year, using about 300 million pounds of make-up between each one.

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Prevention of Turbine-Blade Deposits, by George C. Daniels, Mem. ASME, The Commonwealth and Southern Corporation, Jackson, Mich. 1948 ASME Semi-Annual Meeting paper No. 48—SA-25 (mimeographed).

Turbine-blade deposits can occur only when solids are carried over with the steam. The most logical way to prevent the carry-over is to eliminate the solids from the boiler water by the use of evaporated make-up and no feedwater treatment. In a straight condensing plant with evaporated make-up water the usual source of contamination is the condenser leakage and evaporator carry over plus various chemicals which, according to generally accepted practice are fed into the boiler. Various reasons are advanced for adding chemicals to the boiler water, such as to raise the pH

of the boiler water, to remove all traces of oxygen, to counteract any condenser leakage, to maintain certain chemical ratios, and the like.

The purpose of this paper is to show from results of 22 years of operation that the use of boiler-feedwater treatment is unnecessary and that the total solids in the boiler water can be maintained at such a low value that no difficulty is encountered with turbine-blade deposits. This experience covers operating experience with 400-psi and 900-psi boiler pressures in the various plants of a utility system.

The feedwater cycle in all of these plants, both 400 psi and 900 psi, is similar. Deaeration is accomplished in the condensers, no deaerating feedwater heaters are used, and a common suction heater connected to an elevated surge tank is used for supplying all boiler feed pumps, even when supplying both 400-psi and 900-psi boilers in the same plant. Evaporated make-up water from concrete clear wells in the older plants and steel clear wells in the newer plants is deaerated by spraying into the condenser.

Low Silica Content of Boiler Water Minimizes Turbine Silica Deposits, by J. N. Ewart and T. J. Finnegan, Mem. ASME, Niagara Electric Corporation, Buffalo, N. Y. 1948 ASME Semi-Annual Meeting paper No. **48—SA-34** (mimeographed).

The Niagara Hudson System has operated three high-pressure units from six to eight years with relatively little trouble from silica. While silica deposits on the blades, it is not heavy enough to reduce capacity nor interfere with continuity of operation during the three-year periods between scheduled openings of the turbine, and indications are that the operating period could be extended for at least a year and probably longer before the removal of silica deposits would become necessary. Since the turbine is opened for regular inspection and overhaul on that schedule, however, silica is customarily removed at that time by fly-ash blasting.

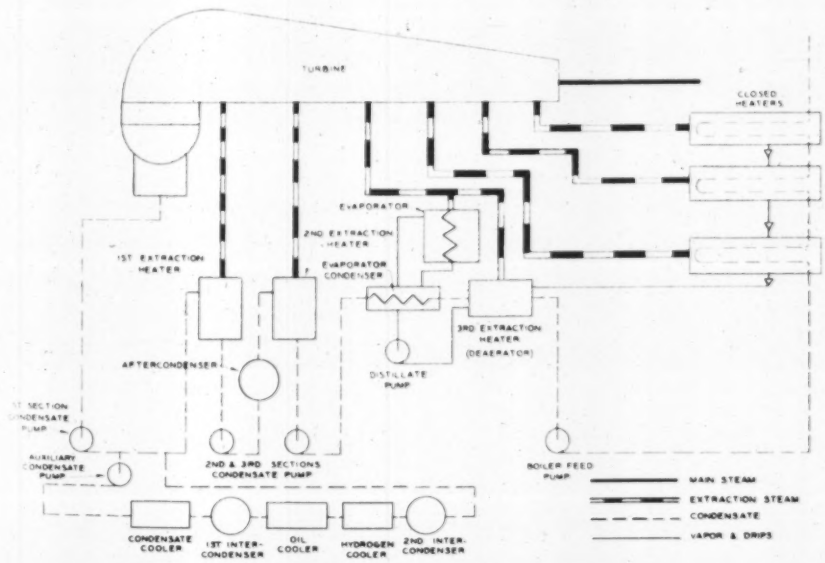
The reason for the relative mildness of the silica problem is that a completely isolated single boiler/single turbine design is used which facilitates keeping the silica content of the boiler water at but a few parts per million by limiting the amount added to the cycle.

The entire steam and feedwater cycle of each unit is separate from the adjacent units so that any contamination such as condenser leakage that might occur at one unit does not affect the rest of the station. The losses from an isolated cycle of this type can be kept low so that but a few tenths of a per cent make-up are required. This is supplied by a 30,000-lb per hr evaporator operated for a few hours at a time at a rating which seldom exceeds 10,000 lb per hr. Operation of the evaporator below its rated capacity enhances the purity of the vapor.

An important factor in keeping the amount of make-up low is the use of air instead of steam for soot blowing.

Each boiler is rated at 900,000 lb of steam per hr and the turbine at 80,000 kw. It is a single-cylinder, 17-stage, 1800-rpm machine with six extraction points. The steam enters the turbine at 1250 psig and 900 F. The make-up is of the order of 0.2 per cent and has been found by analyses to contain about 0.01 ppm silica.

The boiler water contains less than 100 ppm total solids. Both free PO_4, OH, and total solids tests are run monthly or oftener to determine the turbine extraction pressures under a constant control-valve setting which is near the maximum load at which the overload valves remain closed so that all the steam passes through all the stages. This load is about 70 megawatts, varying somewhat for the different machines. At the same time, the turbine heat rate is determined. Graphical records of extraction and heat rate are kept; thus any falling off in turbine performance is indicated and whether or not it is the result of fouling of the blades. Loss in capacity or efficiency due to blocking of the passages with silica has not been found.



FLOW SHEET OF UNIT CYCLE

Research Program on Steam Contamination and Turbine-Blade Deposits in High-Pressure Power-Plant Operation at the Armour Research Foundation, by H. E. Robison, Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill. 1948 ASME Semi-Annual Meeting paper No. **48—SA-49** (mimeographed).

The project on "Steam Contamination and Turbine-Blade Deposits in High-Pressure Power-Plant Operation" was established at the Armour Research Foundation on Jan. 10, 1947, by the Edison Electric Institute, the Association of Edison Illuminating Companies, Babcock and Wilcox Company, Combustion Engineering Corporation, Foster-Wheeler Corporation, Allis-Chalmers Manufacturing Company, General Electric Company, and Westinghouse Electric Corporation. The work is under the general direction of a steering committee.

The purpose of the project is to discover how to eliminate turbine-blade deposits. At the first steering-committee meeting, which was held Feb. 6, 1947, it was decided that the main emphasis should be on insoluble deposits on turbine blades although the project will be concerned with both soluble and insoluble deposits occurring anywhere in the steam system. Because silica and insoluble deposits are most prevalent at the higher pressures, the project is at present more or less limited to plants operating above 600 psi. It was pointed out that many of the opinions held regarding the problem are unreliable and that factual information that is completely understood is of real value. The committee also stated that some of the present analytical methods are not reliable and it may be necessary to develop special methods.

Because the personnel assigned to the

project had had no previous experience with the problem and because of its complexity and the incompleteness of pertinent fundamental knowledge, the main activities during the first year were concerned with the acquisition of an adequate background in order to determine a rational approach toward a solution to the problem. Also, the spectrophotometric method of silica analysis was investigated rather thoroughly and some preliminary work was done on a spectrographic method.

The work done up to March, 1948, is summarized.

Induction Heating

Designing for High-Frequency Induction Hardening, by J. T. Temin, Ohio Crankshaft Company, Cleveland, Ohio. 1948 ASME Semi-Annual Meeting paper No. **48—SA-32** (mimeographed; to be published in Trans. ASME).

Many design problems found in high-frequency induction-heating applications are going unanswered because there are too few engineers trained for this type of work. Also, because of the accelerated war work, application and design engineers have had little opportunity to study, reorganize, and assimilate the technical advances made.

There appears too, the engineers' reluctance to adopt induction heating for hardening because of a fear of using a tool so startling in its application; and a misapprehension of the knowledge required for its operation. For it can be said that the combined subjects of metallurgy and electrical and heat-transmission engineering do present a formidable obstacle to the new user of induction-heating machines.

Applications for high-frequency induction heating are increasing rapidly and have already taken hold in such fields as hardening crankshafts, camshafts, gears, piston pins, wearing surfaces of many kinds, guide rails, knife-edges, etc. The designing engineer assigned to the job can be qualified if he is familiar with the fundamental heating requirements, metallurgical fundamentals, and types of fixtures now in use.

This paper attempts to recognize the problem confronting engineers who are responsible for the designing of equipment to be used for induction-heating applications. It includes metallurgical and definition fundamentals and points out the importance of frequency and time as a basic consideration for designing equipment. Various types of induction-heating processes are discussed with limitations and advantages of each as determined from practical applications. The paper also points out the types of induction-heating methods best adapted for hardening various types of parts. In processing these parts, the engineer must exercise caution in designing parts to meet the specifications set up by the process engineer or the metallurgist.

Heat Transfer

An Extension of Two-Steam Heat-Exchanger Theory to Include the Effect of Longitudinal Conduction, by P. R. Trumpler, Jun. ASME, Clark Brothers Company, Inc., Olean, N. Y. 1948 ASME Semi-Annual Meeting paper No. **48—SA-11** (mimeographed).

The general theory of heat transfer in surface exchangers is adequate for most industrial heat-exchanger problems. In certain special applications, such as exchangers in recent deep-refrigeration process plants and the gas-turbine recuperator, certain so-called "secondary" effects may be of importance and should not be overlooked. One of these is heat flow to or from the outer shell of the exchanger. Another is the heat flow along the shell and the walls in response to a temperature gradient in the fluid-flow direction. This paper investigates analytically the latter effect in combination with external heat loss. The differential equations for a two-stream exchanger subject to external heat loss to constant-temperature surroundings, and also to longitudinal conduction effects, are established. These equations are solved for the case of exchangers with interconnected walls, and a problem illustrating the application of the solution is presented.

Thermal-Contact Resistance of Laminated and Machined Joints, by A. W. Brunot, Mem. ASME, and Florence F. Buckland, General Electric Company, West Lynn, Mass., and Schenectady, N. Y., respectively. 1948 ASME Semi-Annual Meeting paper No. **48—SA-27** (mimeographed; to be published in Trans. ASME).

Values of thermal contact resistance are reported for two types of joints: (1) the joint between two blocks of laminated steel, either in direct contact or separated by cement or shims of steel, aluminum, or aluminum foil; (2) the joint between two blocks of cold-rolled steel with various surface finishes. The resistance as measured amounts to 0.3 to 8 in. of additional material, depending on the configuration. Results are also given in terms of contact resistance.

The tests on laminated steel blocks indicate that if a thick metal shim is used between the two surfaces, the hardness of the shim metal has little effect. If aluminum foil is substituted the resistance is lowered as pressure is increased. This is probably due to the fact that the laminations are embedded deeper in the foil. For more than five layers of foil the effect seems to be slight and the resistance may be increased as the number of layers becomes large due to the resistance between the layers of foil.

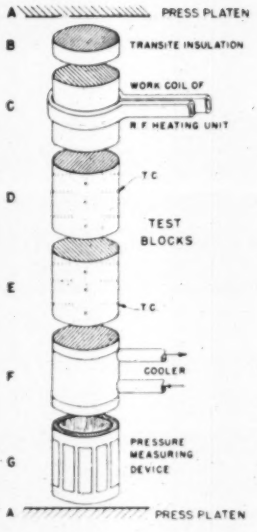
The tests on solid steel blocks with various degrees of smoothness indicate that the smoother the surface the lower the resistance. This may be due to the thinner layer of air or the larger area of contact encountered.

If the gas between the surfaces is other than air, the resistance may be expected to increase or decrease, according to the greater or less resistivity of the gas as compared with air. The effect of changing the gas has not been investigated. The amount of increase or decrease in surface resistance probably depends upon the roughness of surface in contact as well as upon the thermal conductivity of the gas.

Thermal-Resistance Measurements of Joints Formed Between Stationary Metal Surfaces, by N. D. Weills, The Texas Company, Beacon, N. Y., and E. A. Ryder, Pratt and Whitney Aircraft, East Hartford, Conn. 1948 ASME Semi-Annual Meeting paper No. **48—SA-43** (mimeographed).

This paper describes experimental work and its interpretation conducted at the Beacon Laboratories of The Texas Company, in evaluation of the thermal resistance of joints formed between stationary metal surfaces. This work was a portion of a comprehensive program conceived by Dr. Charles E. Lucke, Fellow ASME, professor emeritus of mechanical engineering, Columbia University, and organized by Pratt and Whitney Aircraft, to study the several heat paths of an engine cylinder and to measure their resistances. The objective of this program was to make possible an increase in the horsepower output of high-duty aircraft engines by the reduction through analysis and study of the resistances to the dissipation of combustion heat, but the thermal-resistance data reported here apply equally well to all classes of machinery in which heat transfer through stationary joints is a factor.

Results are presented of the measurements of the thermal resistance (the data are actually expressed in terms of thermal conductance) of dry and oil-filled joints formed between two flat surfaces of



TEST APPARATUS

various metals used in the manufacture of aircraft engines. Thermal-conductivity data on oils also are included.

Apparatus consisted of two test blocks 3 in. in diam × 3 in. long, stacked axially on one another, in contact with an inductively heated copper block at one end and with a water-cooled copper block at the other, and placed between the platens of a hydraulic press. The thermal conductance of the joint formed between the two test blocks was obtained from the measured heat flow and temperature gradient through the blocks and studied as a function of temperature, pressure, and surface finish.

The temperature at the joint ranged from 300 to 500 F, the thermal current across the joint from 10,000 to 130,000 Btu/hr/ft^2, the temperature drop across the joint from 1 to 100 F, and the pressure on the joint from 2 to 8000 psi.

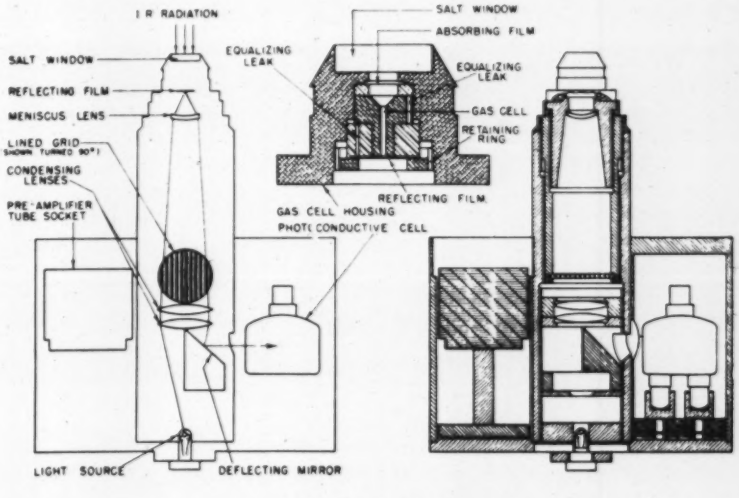
The results of this experimental work emphasize the need for smooth finishes and tight fits between surfaces forming a joint which is expected to transmit heat. The thermal resistance of such a joint is decreased by increasing the temperature and pressure, by the inclusion of oil, or by plating the surfaces with a soft metal.

In reporting the results of this investigation, a physical picture of the mechanism of heat transfer across a joint formed between stationary surfaces is first given, employing the concept of spreading resistance widely used in the study of the electrical resistance of contacts. This physical picture is an important aid in the interpretation of the experimental results, which are given in the third section of the paper. The second section describes the apparatus and procedure.

Combustion Studies Using the Golay Photothermal Detector With an Infrared Monochromator, by John T. Agnew, Jun. ASME, The Franklin Institute Laboratories for Research and Development, Philadelphia, Pa. 1948 ASME Semi-Annual Meeting paper No. **48—SA-16** (mimeographed; to be published in Trans. ASME).

In a search for experimental methods of determining temperature-time and composition-time data for gaseous explosions, the possibility of using the modern fast detectors in the near infrared region of the spectrum (1 to —20) is being investigated at The Franklin Institute Research and Development Laboratories. A brief survey of infrared detectors is given and the first preliminary experiments are described. An eight per cent methane-in-air mixture was ignited by means of a spark in a steel combustion bomb. The spectral distribution of the energy radiated by the burning gases from 1 μ to 11 μ was determined as a function of time. This was accomplished by means of a special low-dispersion monochromator utilizing a Golay photothermal detector.

The pneumatic detector operates as follows: Infrared radiation passes through a halide (usually sodium chloride) window and strikes an aluminized film which forms the closure for one end of a tiny gas cell. The transabsorption characteristics of this film must of course be carefully maintained to the proper value. Energy absorbed or transmitted by the aluminum film is transferred to the gas in the cell, thus causing a rise in the temperature and pressure of the gas. As a result, there is a dilation of an antimony film which forms the closure for the other end of the gas cell. A path is provided for gas leakage around the component parts forming the gas cell, and the impedance to the flow of gas can be varied. This adjustment has much to do with the speed of response and sensitivity of the detector. The dilation of the antimony film is detected and evaluated by means of an optical system which incorporates a lined grid to provide light modulation to a light-sensitive cell. Light from a small filament passes through one half of a pair of condensing lenses which focuses the light on the antimony film forming one end of the gas cell. The antimony film acts as a mirror. Immediately after leaving the second condensing lens, the light passes through the top half of a lined grid, consisting of alternate transparent and opaque lines. A small meniscus lens placed near the antimony film causes an image of the top half of the grid to be formed on the lower half of the grid after reflection from the antimony film. Thus with quiescent conditions, and the proper positioning of the grid and lenses, a minimum amount of light passes through the lower half of the grid to the light-sensitive cell. Theoretically, no light would pass through if the image of the opaque spaces on the top half of the grid were formed on the transparent spaces of the bottom half of the grid. Reception of infrared energy and the resultant dilation of the antimony mirror causes a shift in the position and dimensions of the grid image with the result that some light passes through the lower half of the grid to the light-sensitive cell. The light-sensitive cell used was a thallium sulphide photoconductive cell, which has been found to have a higher signal-to-noise ratio than ordinary phototubes or photomultipliers for the degree of light intensity used in this application. The reception of increasing amounts of energy cause larger signals up to a certain point when more energy results in the



PHOTOTHERMAL DETECTOR
(Optical system and assembly.)

passage of less light through the grid combination and a decreased signal results. However, at low-energy levels the response is linear.

The possibility of using the data for the determination of temperature and composition is discussed.

Projection Welding

Modern Projection Welding, by Robert A. Reich, The Ohio Nut & Bolt Company, Berea, Ohio. 1948 ASME Semi-Annual Meeting paper No. **48—SA-17** (mimeographed).

Projection welding is a method of resistance welding whereby the current-flow and heating during the welding operation are localized at predetermined points called "projections" or "embossments." There is said to be no faster, more economical, or stronger method of attaching fasteners than by projection welding.

Fasteners provide the means by which the component parts of an assembly are held together. When determining whether a job should be projection-welded the following factors should be considered: (1) The materials used must be suitable for projection welding; (2) the work to be welded must be so designed and of a size to enable it to be carried to the welder; (3) the quantity must be large enough to warrant the cost of tooling up; and (4) suitable welding equipment must be available.

One of the most important advantages of projection welding has been the economy of attaching parts of irregular shape to sheet metal which could not be spot-welded.

Many times, three or four products of the same design can be welded in one operation and consequently the cost of welding is greatly reduced.

When a design includes fasteners which are to be projection-welded it is important to set up the correct material specifications. Many materials may be suitable for projection welding but are difficult or impossible to upset and cold-work. The following materials are well-suited in both respects: low carbon steel (carbon 0.20 per cent max), naval brass, monel, stainless steel (18–8).

It is much better to specify a fastener to be made in low carbon steel with the diameter or area of the product increased to obtain the same strength as the product would have if made from 1035 or 1045 steel. Many times, when welding steel over 0.20 carbon it is necessary to preheat before welding or use a postheat after welding in order to reduce the cooling rate.

Hydraulics

Performance Criteria for Positive-Displacement Pumps and Fluid Motors, by W. E. Wilson, Mem. ASME, Sundstrand Machine Tool Company, Rockford, Ill. 1948 ASME Semi-Annual Meeting paper No. **48—SA-14** (in type; to be published in Trans. ASME).

The comparison of performance characteristics of positive-displacement pumps and fluid motors on the basis of dimensionless performance coefficients and dimensionless efficiency curves is presented as a substitute for the present methods. It is shown that the coefficients describe performance adequately and are subject to significant interpretation in terms of the geometry of the unit. The dimensionless efficiency curve is shown to have advantages in presenting a wide range of data and in prediction of performance characteristics under any specified operating conditions.

The general confusion with regard to methods of presenting positive-displacement-pump and motor-performance data with particular reference to lack of agreement in definition of terms led to the preparation of the method of performance-data analysis and comparison described in this paper. Clarification of definitions of efficiencies, and the introduction of coefficients of performance and their definitions are attempted in order to provide a logical and adequate means of describing performance.

Steam Power

Design of Main Cylinder Joints for Steam Turbines, by E. M. Golonka, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. 1948 ASME Semi-Annual Meeting paper No. **48—SA-28** (mimeographed).

Although only a limited number of steam-turbine cylinder horizontal joints have steam leaks when first placed in service, these leaks are a source of annoyance and expense. Herein are suggested joint, flange, and bolting practices emanating, to a great extent, from an elementary stress check used in a study of both leaky joints and joints that have been steamtight in service. As a result of the correlation of this work, three joint stress requirements are presented and if adhered to will assure a good and reliable horizontal joint design.

With the increasingly higher operating pressures and temperatures in power plants the proper design of the horizontal joint on a high-pressure steam-turbine cylinder has become a problem of considerable importance from the standpoint of preventing steam leakage in this joint during normal operation. Although steam joints have been carefully designed, steam leakage has occurred in a few installations. Such leakage is usually corrected after initial operation of the turbine.

It was decided to make a detailed study of the joint design of a number of large steam turbines in which no leakage difficulty had developed in service, as well as units in which trouble occurred. Information obtained from this study was used in the development of a method of horizontal joint design which should prove more reliable. This paper presents the results of this investigation and the conclusions reached.

Steam-Turbine Governor Regulation, by C. E. Kenney, Mem. ASME, G. E. Scott, Jr., Mem. ASME, and C. L. Ringle, Mem. ASME, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. 1948 ASME Semi-Annual Meeting paper No. **48—SA-44** (mimeographed).

This article explains the following elementary concepts of steam-turbine governor regulation: What it is; how it is measured; and how it affects the operation of turbine-generators. The explanations and examples are based on a type of governing system used by the authors' company.

The study of regulation developed primarily for the following reasons: The need for closer frequency tolerances, the ever-expanding tie-ins between systems having different regulations, and the desire to increase the efficiency of power systems by fully utilizing the operating characteristics of each turbine-generator and boiler.

In developing the fundamentals of regulation, a simple governing system which has a flyball governor, a speed changer, a load-limiting device, a hydraulic servomotor and a cam-operated steam-inlet valve is considered. It is designed to control the steam flow to the turbine by moving the inlet valve in the closing direction when turbine speed increases. To obtain stable operation of the unit, lost motion and binding of the moving parts must be minimized and its inertia must be low.

An example is given of the two sets of data required for a study of this system—the governor lift versus speed relation and that between main servomotor stroke and load. Curves are plotted of this data and of the resulting regulation calculations so that all concerned members of the company will use this form in presenting governor test data. It is believed that the information given will help the understanding of governor systems.

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Energy-Release Rates in Furnace Cavity

To the Editor:

The curve, Fig. 1, showing the relation between maximum time mean energy release rate in a furnace cavity and the fraction burned at escape from a furnace cavity, is taken from a recent work of the writer.[1] It is based upon a comparison of mean ordinates under the curve, Fig. 5, of another paper[2] also by the writer. It represents the relation between time-mean energy release rates in a furnace cavity and the fraction fuel burned x, at escape from the cavity for the conditions shown.

The relationship illustrated should be of considerable practical interest. Although the curve shown is developed from data for a perfect mixture and applies, strictly speaking, only to this case for the conditions shown, values taken from the curve should apply approximately to the real case of natural gas-firing when the excess air is 20 per cent (i.e., $y = 1.2$) if all of the air enters through the front end with the fuel. In fact, the curve should indicate the order of magnitude of energy-release rate ratios, shown for any gaseous or vaporous fuel of low inert content with $y = 1.2$, if all air enters through the front end with the fuel, and if the furnace pressure is approximately 1 atm.

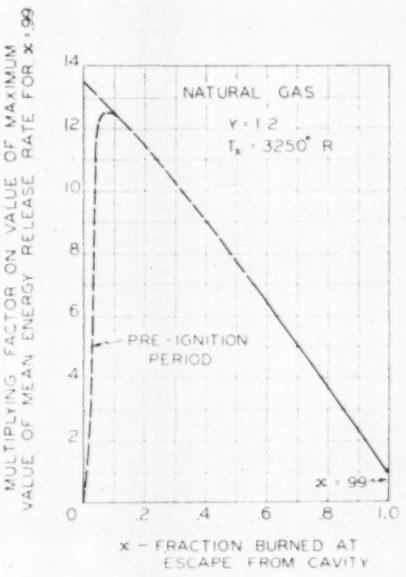


FIG. 1

W. J. Wohlenberg.[3]

[1] "Influence of the Geometrical Properties of a Burning Air-Gas Mixture on the Rate at Which Combustion Occurs Within the Mixture," by W. J. Wohlenberg, Yale Scientific Magazine, April, 1948.

[2] "The Influence of Reaction Interface Extension on the Combustion of Gaseous Fuel Constituents," by W. J. Wohlenberg, Trans. ASME, vol. 70, April, 1948, pp. 143–160.

[3] Professor of Mechanical Engineering, School of Engineering, Yale University, New Haven, Conn. Fellow and Former Vice-President, ASME.

Engineering Education

Comment by Richard D. Hug[4]

The following statement appeared in a recent issue of this publication:[5] "We believe that he (the engineering graduate) should have been well trained in the three concurrent stems of mechanical engineering: (*a*) thermodynamics and heat power, including fluid flow and heat transfer, (*b*) machine design, including engineering drawing, mechanics, and engineering materials, and (*c*) industrial engineering, including economics, accounting, and a study of industrial organizations."

Why is it necessary for all mechanical engineers to be well trained in thermodynamics and associated subjects? Many of us have no interest in these phases and will never be confronted with situations calling for such knowledge.

"You never can tell when it may come in handy," is obsolete. The scope of the engineering field is too great for one person to be well trained in everything that may come in handy. Somewhere a line must be drawn. There are many fields of knowledge which are not in the mechanical engineer's curriculum but which are much more helpful to some of us than a knowledge of thermodynamics.

One very good example of this was quoted in the report. ". . . a very great need exists for imparting to undergraduates a much clearer understanding of the obligations and responsibilities of professional status, code of ethics, employment relations and opportunities, state-board registration, traditions and ideals of the professions, organization and function of engineering societies, and much else within the general area." I agree heartily with Dean Freund. This "general area" is neglected almost altogether in some curricula.

No matter what phase of engineering the graduate chooses, he will come in contact with the whole area covered by (*b*) and (*c*), but not necessarily so with (*a*).

Becoming well trained in a phase with which he has no need or desire to come in contact, utilizes valuable time that could be used to much greater advantage by taking courses directly related to his chosen phase of mechanical engineering or general courses in zoology, genetics, psychology, etc. (Many engineers will guffaw at the prospect of taking such subjects as zoology or genetics, but the average engineer would do well to help himself become a better husband and father. As well as a living to earn, he has a life to live.)

Design engineers whose product has no connection with fluid flow, thermodynamics, etc., have no need for these subjects. Most process and production engineers do not need them. The percentage of engineers in the field who have no need for the training they received in thermodynamics certainly is large enough to warrant dropping this training from the list of required courses. This would leave room for more subjects that help to mold a well-rounded education.

[4] W. A. Sheaffer Pen Company, Fort Madison, Iowa. Jun. Mem. ASME.

[5] "Mechanical Engineering Education Conference," Mechanical Engineering, vol. 70, May, 1948, pp. 434–435.

Our Way of Life

To the Editor:

I commend the publication of F. A. Faville's report on the teaching aspects of this subject.[6] I believe that similar discussions should be published continu-

[6] "Teaching Our Way of Life—Program of ASME Engineers Civic Responsibility Committee for 1948," by F. A. Faville, Mechanical Engineering, vol. 70, May, 1948, pp. 404–406.

ally. The need is great and it is urgent.

In attempting to straighten out such misconceptions over the past eighteen years, I have been deeply disappointed by the lack of knowledge of our way of life by our college seniors. My earlier work in industry showed more conclusively the deficiencies of our educational system. Mere literacy is no guarantee of intelligence.

I think Mr. E. B. Gallaher is correct when he states,[7] "our schools and colleges are largely responsible for the lack of discipline and lost Americanism existing among the young people of today." Perhaps those of our members having influence with local school committees can see that some of the chaff in our common school system is replaced with courses which lead our youth to think.

The accomplishments listed by Mr. Faville are encouraging, but they do not warrant a feeling of complacency. What we need is more action.

I am not at all sure that we should not write letters to our Congressman. My Representative in Congress once wrote me that he had only eight letters on a certain subject from his entire constituency. It passed in Congress by one vote.

I strongly urge that this matter be kept alive constantly by publication of more articles like this one.

CARROLL D. BILLMYER.[8]

[7] "American Ordnance Letter no. 23," by E. B. Gallaher.

[8] Associate Professor of Mechanical Engineering, Rhode Island State College, Kingston, R. I.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Fluid Mechanics

ENGINEERING APPLICATIONS OF FLUID MECHANICS. By J. C. Hunsaker and B. G. Rightmire. McGraw-Hill Book Co., New York, N. Y., 1947. Cloth, 6 × 9 in., 494 pp., illus., $5.

REVIEWED BY ROBERT T. KNAPP[1]

THE prospective user of this book should not be misled by the title into considering that the chief purpose of the volume is to present applications of fluid-mechanic principles supposedly mastered in a previous study of another text. Actually the volume is designed as a first course in the study of fluid mechanics by an engineer who brings to it a basic knowledge of physics, elementary mathematics through differential equations, and a working knowledge of applied mechanics.

The first seven chapters develop the general principles of fluid mechanics. Chapters 8 through 17 develop the applications of these principles to a wide variety of uses in many fields of engineering, including hydrodynamic machines. Chapter 18 is devoted to hydraulic transmissions and controls and their application to servomechanisms.

The book is very modern in its viewpoint and engineers who master it will find themselves much better equipped to cope with a wide range of nonstereotyped problems than is the average practicing hydraulic engineer or aerodynamicist. Some individuals may feel that the book is too difficult for the first course in fluid mechanics. It is the reviewer's impression, however, that the good average engineering student studying in a modern technical school or university will not find it so, but will welcome it as one of the outstanding texts he uses. Many engineering texts appear to avoid the use of anything but the simplest physical and mathematical principles even though the modern college curriculum goes to considerable pains to give the student a thorough knowledge of much more advanced workmaterial in these branches. This text simply and correctly assumes that the student can and wishes to utilize the material that he has been studying for the past two years and thus asks him to expend his energy in acquiring new knowledge built on top of what he has already been taught.

The application of this viewpoint has resulted in a presentation of a surprising amount of material in a volume of moderate size. The development of the general principles includes not only a thorough discussion of the equations of energy and continuity but also a development of the Euler equations and a mathematical discussion of the dynamics of the ideal fluid. A good treatment of dimensional analysis and similitude lays the foundation for a rational approach to laboratory investigations in the field. The section on application of the general principles starts properly with a discussion of flow in closed conduits. Incompressible fluid flow is first considered. It is used as a basis for the discussion of laminar flow, the development of turbulence, and the investigation of laminar and turbulent boundary layers. The following chapter deals with compressibility phenomena and considers not only the flow of a compressible fluid in a closed channel, but also the motion of a body in a compressible fluid at both subsonic and supersonic speeds. The consideration of the motion of a body in a fluid is then expanded for two additional chapters and includes rather extensive treatment on wing theory. Following this an equally extensive treatment is given of hydrodynamic lubrication. The remainder of the text is concerned with hydrodynamic machinery, including hydraulic turbines, pumps, fans, compressors, propellers, and jets (with a brief description of rocket mechanics), fluid couplings and torque converters, and finally the chapter, as previously mentioned, on hydraulic transmissions and servomechanisms.

It will be seen from this enumeration that considerable pains are taken to give the user of this book a concept of the breadth of application of fluid mechanics to many fields of engineering. One notable omission is that there is no treatment of the flow in open channels, nor for that matter, of wave phenomena except as it applies to supersonic flow. Of course, it is impossible to include all topics in a given field in one volume, but it is probable that the average engineer who is interested in the field of fluid mechanics would benefit more by a good fundamental discussion of steady and transient flow in open channels than he will from the more specialized treatment on hydraulic transmissions and servomechanisms presented in the last chapter.

[1] Director, Hydrodynamics Laboratories, California Institute of Technology, Pasadena, Calif. Mem. ASME.

Some readers may be slightly disappointed that more thermodynamics is not incorporated into the presentation. The authors point out that this omission is due to the fact that in their particular curriculum the student is taking a parallel course in thermodynamics, thus making it undesirable to treat the same topic in both courses.

A very pleasing feature of the book is that a selected bibliography is given at the end of each chapter. Also at the end of the volume there are over 200 well-planned problems which are numbered to correspond with the chapter whose principles they illustrate.

To summarize, it is felt that this is a significant and worth-while presentation. Although the authors state that it is designed primarily for use as a college text, its fields of usefulness should extend to the graduate engineer who is desirous of modernizing his knowledge in the field of fluid mechanics.

Man-Machine Proficiency

PSYCHOLOGY AND MILITARY PROFICIENCY. By Charles W. Bray. Princeton University Press, Princeton, N. J., 1948. Cloth, 5½ × 8½ in., 242 pp., 15 figs., 6 plates, $3.50.

REVIEWED BY THEODORE F. HATCH[2]

BECAUSE of the high degree of mechanization of weapons employed in the recent war, the concept of man-machine as a fighting unit was brought into sharp focus. The most elementary observation revealed, all too often, that the usefulness of a weapon was seriously limited because of failure to take into consideration in its design, the attributes and *limitations* of the soldier as well as functional requirements of the weapon. It was also evident that, with the increasing complexity of weapons, a more basic procedure was required for preselection and training of soldiers for the highly specialized operations required of them. The established methods, based on military experience of the past, no longer served. Demonstration of the fact that the scientific method could be applied to the study of human factors as well as to the physical, resulting in a more effective integration o man and machine into a fighting unit, constitutes, as Captain Smith points out in his Foreword to the present volume, one of the greatest intellectual achievements of the war.

Dr. Bray has recorded the work of one most important group who contributed so much to the development of procedures for the systematic study and solution of problems relating to the human factor—the Applied Psychology Panel of NDRC. Their contributions resulted in the rapid development and firm establishment of military psychology, which is defined by Dr. Bray as: "..... the application of psychology to the development of military aptitude tests and classification procedures; to the training of men; to the design of military equipment for human use; to the simplification of military operating procedures; to the problems of the abnormal soldier or sailor; and to psychological warfare, morale and human attitudes."

The volume deals particularly with the experiences of the Panel in problems of classification of military personnel, selection and training of specialists, classification and training of gun crews, and the design of equipment for the control of gunfire and development of achievement and proficiency tests. The many experiences which are cited prove: (1) That the human problems can be broken down into their essential elements for systematic quantitative analysis; (2) that the scientific method of applied psychology can be effectively employed in such studies; and (3) that, as a result, more meaningful tests are provided for classification and selection of military specialists, training is made more direct and effective, and the designing engineer working with the psychologist, is able to produce a weapon which fits the man more closely than he can otherwise do. The work of the Panel demonstrated the possibility of saving many thousands of man-years in preparation for combat and of increasing combat efficiency manyfold through better integration of man and machine.

The concepts upon which the work was based and the procedures employed were not a part of regular military thinking and it is not surprising therefore that the work of the Panel did not always lead to practical applications. Many projects were undertaken too late in the war to be of use. It is fortunate that the work is being continued, to some extent, in the military services.

The volume provides much more than a record of one phase of scientific activity during the war. One sees many opportunities for the application of the same procedures to the study of industrial operations which present similar problems of integration of man and machine.

[2] Research Director, Industrial Hygiene Foundation of America, Pittsburgh, Pa. Mem. ASME.

The Management-Labor Relationship

GETTING ALONG WITH UNIONS, by Russell L. and Elizabeth B. Greenman. Revised edition, Harper & Brothers, New York, N. Y., Cloth, 5½ × 8 in., 143 pp. $2.50.

REVIEWED BY EDWARD H. HEMPEL[3]

THE revisions made in this well-received book cover primarily references to the Taft-Hartley Act. They explain its pertinent features; the new statute which has to be upheld; and the new rules and regulations on procedures which have to be observed by managements and unions, whenever they intend to deal with each other under the Act and its mechanisms.

Regrettably, the revisions did not include the full text of the Act, which would have been helpful in a reference book, nor do the authors give any sample of a truly good contract from which the newcomer or student or practitioner could learn what such a document looks like and how it should be written.

Aside from these omissions the text covers a highly important field in a thorough and interesting manner. It can be used well as specialized reading for advanced students, and it is certain that even those who actually are in this kind of work will enjoy the frank and forward comments of the authors on the brighter and darker sides of bargaining and contract writing.

Especially good and pertinent are the chapters on: Union objectives in collective bargaining; management strategy in contract negotiation; negotiating wage changes; and management safeguards in union agreements.

All these are ticklish subjects, and while the authors aim to give best counsel and recommend fairness all around—upon most serious reflection of the so thoroughly disappointing conditions which have been created in management-labor relations under all the laws, acts, rules and regulations, negotiations, mediations, arbitrations, conciliations, boards and authorities, with and without the help of politicians, lawyers, advisers, councilors, and by the application of intricate and hairsplitting procedures and language—one cannot help but doubt the practicability and usefulness which is claimed by so many for the legal and legalistic approach in labor-management relations.

[3] Adjunct Professor, Industrial Engineering, Graduate Division, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.; Chairman Small Plants Committee, ASME.

The authors say, "Bargaining between management and the union is meant to be a means of exploring each other's mutual and individual problems, and getting to learn more about one another. The bargaining table is not the place to demonstrate superiority or anger or hatred. For the management representative to foster a spirit of hostility, intolerance, and caste-consciousness is downright smug. It is stupid. Being able to create a spirit of friendliness, tolerance, and equality is a gift that it pays to cultivate."

If the authors can be encouraged at all, they might well expand this, their own statement, into a companion book, especially written for the use of union representatives who too seem to need enlightenment on the other aspect of bargaining, which is *Getting Along With Managements*. It is not always management which causes long-drawn-out strikes, heavy loss of wage income to the workers, weeks of futile negotiations, a spirit of hostility, exorbitant demands, and similar features which so sadly handicap the management-labor relationships of our days.

Metal-Cutting Tools

DESIGN OF METAL-CUTTING TOOLS by Frederick L. Woodcock. McGraw Hill Book Company, New York, N. Y., 1948. Cloth 6 × 9 in., 406 pp., illus., $5.

THE author has prepared this text on the basis of his own experience over a period of years and data collected during that time and kept up to date as conditions changed. In addition he has had the assistance of a number of the leading manufacturers and the co-operation of men actively engaged in the design and use of cutting tools.

The text is based on a series of questions for which the tool engineer or draftsman should find answers before a layout is started. Divided into two major sections covering "Fundamentals of Design" and "Details of Design," the text covers these subjects thoroughly in a readable and concise manner. A 62-page appendix covers detailed specifications as recommended by some of the leading tool manufacturers.

Careful analysis of the basic principles on which all cutting tools act, the requirements for proper maintenance, inspection, and sharpening, together with a discussion of heat treating and cutting fluids, prepares the reader for the more extensive section on design.

Under design each type of tool is analyzed as to its purpose and action in cutting. Factors to be avoided are dealt with as carefully as those that are of advantage to correct operation.

This text is well planned and presented and will be of considerable benefit to those engaged in the design of cutting tools. It would be somewhat more useful if the illustrations had been more carefully keyed into the text. The numerous individual items discussed are well covered in a six-page index.

R. B. S.

Panel Heating

PANEL HEATING AND COOLING ANALYSIS. By B. F. Raber and F. W. Hutchinson. John Wiley & Sons, New York, N. Y., 1947. Cloth 5½ × 8¼ in., 208 pp., illus., $3.50.

REVIEWED BY E. L. KNOEDLER[4]

THE authors have made an excellent contribution to the subject of panel heating and cooling. They have prepared an authoritative review of the subject and have traced the historical background necessary to compare the advantages and disadvantages of this type of system with other present-day systems.

The text includes a comprehensive presentation of the theory of panel heating and cooling in which the subject matter is developed mathematically. The rigorous discussion includes treatment of shape factors, comfort equations, and heat balances essential to proper design. Meticulous attention to these factors and related details has made it possible to develop design procedures applicable to highly specialized and unusual problems in panel heating and cooling.

The authors have recognized the need to simplify calculations used in the solution of the average problem. For this purpose they have introduced graphical methods and have shown the value of the application of the concept of conductance.

The text is particularly interesting because of the practical approach which has been accomplished without sacrificing fundamental theory. Thus the book will serve as a text for advanced students in this field and as an authoritative reference for the architect, contractor, and engineer.

[4] Engineer, Sheppard T. Powell, Baltimore, Md. Mem. ASME.

Radiant Heating

RADIANT HEATING. By Richard Woolsey Shoemaker. McGraw-Hill Book Co., New York, N. Y., 1948, 6×9 in., 306 pp., illus., $4.

REVIEWED BY E. L. KNOEDLER[4]

THIS book is an interesting presentation covering a relatively new field. It is written in a semipopular style that should appeal to prospective home owners, contractors, and engineers alike. The material is well-organized and treated by the author, so the subject is made readily understandable. Amplifying the text are excellent illustrations so the reader can see personal applications whether for home or industrial use.

The author discusses the most desirable arrangement of heating panels in structures, the type of heating plant required, and the necessary controls for adequate operation of the system. There is included the basic theory essential to proper design and installation of radiant-heating systems under varying climatic conditions and architectural requirements.

Radiant cooling, one of the companion features of radiant heating is described in sufficient detail to permit evaluation of its potential uses. The practical aspects of radiant-heating and cooling systems are emphasized by means of typical examples.

Books Received in Library

ALUMINIUM AND ITS ALLOYS. By N. F. Budgen. Second edition. Sir Isaac Pitman & Sons, Ltd., London, England, 1947. Cloth, 5½ × 8¾ in., 369 pp., illus., diagrams, charts, tables, 25s. This book provides an outline of the various branches of metallurgical work related to and comprising the aluminium industry. It describes the properties, processes, and methods employed in the manufacture of aluminium and its alloys, and their applications to modern engineering This edition has been revised and brought up to date to include the latest developments in this branch of metallurgy.

AMERICAN SOCIETY FOR METALS, Transactions, volume XL, 1948. American Society for Metals, Cleveland, Ohio. Cloth, 6 × 9¼ in., 1164 pp., illus., diagrams, charts, tables, $10. Forty-two papers presented to the society during 1946 and 1947 are collected in this volume. The wide range of subject matter covered includes physical chemistry, metal-cutting and forming, heat-treating, metallography, and the properties and characteristics of various metals and alloys. Technical discussions accompany the papers.

COMBUSTION ENGINEERING, a Reference Book on Fuel Burning and Steam Generation. Edited by O. de Lorenzi. Combustion Engineering Company, New York, N. Y., 1947. Cloth 6 × 9¼ in., paged in sections, illus., diagrams, charts, tables, $7.50. This book deals with the various methods and equipment used for fuel burning, steam generation, and heat recovery and was prepared by a number of fuel technologists, combustion engineers, and specialists. Brief outlines of early developments, as contrasted with modern designs, are included in many chapters. Selection of equipment and performance calcu-

tions are considered as well as the operation and maintenance of equipment. Numerous tables and diagrams complement the text.

ELEMENTARY THERMODYNAMICS. By V. M. Faires. Revised edition. The Macmillan Company, New York, N. Y., 1948. Cloth, $6 \times 9^1/_2$ in., 268 pp., illus., diagrams, charts, tables, $4.40. Topics of importance for short courses in thermodynamics are given, including energy equations, reversible nonflow gas processes, thermodynamic cycles, compression and expansion of air, liquids, vapors and vapor cycles, refrigeration, nozzle flow, and the properties of mixtures. A large number of small changes have been made in this edition, the most noteworthy addition being a discussion of the theory of the gas turbine.

ELEMENTS OF FUEL TECHNOLOGY. By G. W. Himus. Leonard Hill Limited, London, England, 1947. Cloth 6×10 in., 506 pp., diagrams, charts, tables, 42s. This book gives an outline of some of the problems involved in the correct use of fuel. Both coal and oil are considered as well as the secondary fuels derived from them. Numerous illustrations and references are included. The descriptions and illustrations of plant and apparatus have been taken from British practice.

ELEVEN AND FIFTEEN-PLACE TABLES OF BESSEL FUNCTIONS OF THE FIRST KIND, TO ALL SIGNIFICANT ORDERS. By E. Cambi. Dover Publications, New York, N. Y., 1948. Cloth, $8^1/_2 \times 10^3/_4$ in., 154 pp., tables, $3.95. The main tables give $J_n(x)$ for x ranging from 0 to 10.5 at intervals of 0.01, to eleven places. Supplementary tables give $J_n(x)$ for x ranging from 0 to 0.500 at intervals of 0.001, to 15 places, and Taylor Series for J_n of even order for $x = 2$ to 10 inclusive. The introduction contains an explanation of the tables and graphs which show their accuracy.

FUNDAMENTALS OF AIRCRAFT STRUCTURES. By M. V. Barton. Prentice-Hall, Inc., New York, N. Y., 1948. Cloth, $6 \times 9^1/_4$ in., 298 pp., diagrams, charts, tables, $6. This book emphasizes the fundamental principles upon which the analysis of the structure is made. It begins with the broad subject of loads, becomes more detailed in following the over-all actions of applied loads, and finally narrows down to a study of the stress conditions from point to point of the structural material. Many illustrative examples and problems show the application of principles to modern aircraft. References are given at the ends of the chapters.

THE GENIUS OF INDUSTRIAL RESEARCH. By D. H. Killeffer. Reinhold Publishing Corporation, New York, N. Y., 1948. Cloth, $6 \times 9^1/_4$ in., 263 pp., charts, $4.50. This treatment of modern industrial research and its methods is intended primarily to guide the ambitious young researcher to a better understanding and surer mastery of his craft. The material is mostly from the field of industrial chemistry. The accounts of how many important modern developments were achieved are quoted directly from the original presentations.

HYDRAULIC MACHINERY. By S. R. Beitler and E. J. Lindahl. Irwin-Farnham Publishing Co., Chicago, Ill., 1947. Cloth $6 \times 9^1/_4$ in., 317 pp., illus., diagrams, charts, tables, $3.50. Based on a course in hydraulic machinery for upper-class students in mechanical engineering, this volume describes briefly the theory and practice of a variety of apparatus. Following a review of the fundamentals of the subject are chapters dealing with pipes, meters, weirs, flumes, pumps, and turbines. Compressible fluid flow and fluid drives are also considered. Problems are found at the end of each chapter.

INDUSTRIAL RESEARCH, 1947. Advisory Editor, P. Dunsheath. Todd Reference Books Limited, London, England, and New York, N. Y.; British Distributors: George G. Harrap & Co., Ltd., London, England, Cloth $5^1/_2 \times 8^3/_4$ in., 535 pp., 25s. This British Empire directory contains statements on the character and activities of government, public, and private organizations which have industrial research programs. Careers in industrial research are briefly described, with information on university requirements, grants, etc. Books, periodicals, and films of interest are given in classified groups. The volume also contains lists of laboratories, technical colleges, consultants, libraries, and a "who's who" in industrial research.

INDUSTRIAL WEIGHING. By D. M. Considine. Reinhold Publishing Corporation, New York, N. Y., 1948. Cloth, $6 \times 9^1/_4$ in., 553 pp., illus., diagrams, charts, tables, $10. Written for students, engineers, designers, and users of scales, this book provides a comprehensive study of the subject of scale design and engineering, and of the uses of scales in the process industries. The first part reviews basic scale mechanics, design and construction of modern scales, scale installation, and maintenance. The uses are described in Part 2. A large number of illustrations and diagrams, and a glossary of scale terms are included.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any item in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

INTRODUCTION TO AERODYNAMIC COMPRESSIBILITY. By J. Black. Bunhill Publications, Ltd., London, England, 1947. Cloth, 7×10 in., 115 pp., plates, illus., diagrams, charts, tables, 18s. Primarily intended for the student, this book serves as an introduction to problems, as yet but partially understood, of the fluid flow of air at high speeds. The author clarifies some of the many misconceptions and false premises at present current by both experimental and theoretical data. The book surveys the latest important results and should be of value to those who design streamline bodies, ducts, or turbines.

ASME BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly for the purpose of considering communications relative to the Boiler Code. Anyone desiring information on the application of the Code may communicate with the Committee Secretary, ASME, 29 West 39th St., New York 18, N. Y.

The procedure of the Committee in handling the Cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are then sent by the Secretary of the Committee to all members of the Committee. The interpretation, in the form of a reply, is then prepared by the Committee and is passed upon at a regular meeting.

This interpretation is later submitted to the Council of The American Society of Mechanical Engineers for approval after which it is issued to the inquirer and published in MECHANICAL ENGINEERING.

Following is a record of the interpretation of this Committee formulated at the meeting of May 24, 1948, and approved by the Council on June 28, 1948.

CASE No. 1025

Delete the following sentence in the footnote in this Case:

The effect of residual nickel and copper is much less than that of chromium and molybdenum, but for weldable steels copper should not exceed 0.30 per cent.

CASE No. 1069 (Reopened)

(Interpretation of Specification SA-217)

Inquiry: Is it permissible to use the new Grades WC 5 and WC 9 provided in ASTM Specifications A 217-47T under Specification SA-217 of the Code?

Reply: It is the opinion of the Committee that Grades WC 5 and WC 9 may be used under Specification SA-217 of the Code provided that such provisions for these compositions as are provided in ASTM A 217-47T are followed, and that in all cases the minimum draw temperature shall be not less than 100 F above the contemplated operating temperature. The permissible stresses for these grades shall be as follows:

Temperatures, deg F

Grades	−20 to 650	700	750	800	850
WC5	15000	15000	15000	14000	12500
WC9	14000	14000	14000	13500	12000

	900	950	1000	1050	1100
WC5	10200	8250	6250	4500	..
WC9	10300	8250	6250	4800	3700

CASE No. 1070

(Interpretation of Par. P-180d)

Inquiry: Par. P-180(**d**) requires that all weld reinforcements on both inside and outside of the plates at the longitudinal and circumferential seams shall be removed substantially flush with the surface of the plate on pressure parts where the design stresses exceed those given in Table P-7 as permitted under Pars. P-180(**c**), P-198(**a**), or A-125.

Is it the intent of the Code that the inside backing ring be allowed to remain at the circumferential welded seams of headers designed with the increased stresses? Is it the intent of the Code that the formulas in Par. P-180 be used to determine the minimum thicknesses of circular downcomer headers?

Reply: It is the opinion of the Committee that the inside backing rings may remain at the circumferential welded seams of headers designed with the increased stresses, as permitted under Pars. P-180(**c**), P-195(**l**), P-198(**a**) orA- 125, provided such construction complies with the requirements of Par. P-112.

It is the opinion of the Committee that the formulas in Par. P-180 may be used for determining the minimum thicknesses of the circular downcomer headers, provided the outside diameter of the headers exceeds the largest tube diameter indicated in Table P-2.

CASE No. 1071

(Special Ruling)

Inquiry: May alloy steel tubing be used for boiler and superheater tubes as a special grade under Specification SA-213, Grade T13, having the following chemical composition:

Carbon, max, per cent.....0.15
Manganese, per cent.....0.30 to 0.60
Phosphorus, max, per cent..0.030
Sulphur, max, per cent.....0.030
Silicon, per cent.....1.00 to 1.40
Chromium, per cent.....2.75 to 3.25
Molybdenum, per cent.....0.45 to 0.65

Reply: It is the opinion of the Committee that tubes complying with the above specification may be used as a modification of Specification SA-213, Grade T13, with the same design stresses as permitted in Table P-7 for Grade T13.

CASE No. 1072

(Special Ruling)

Inquiry: May seamless alloy steel piping complying with ASTM Specifications A 315-47T for Seamless One Per Cent Chromium 0.5 Per Cent Molybdenum Alloy-Steel Pipe for Service at High Temperatures be used interchangeably with material complying with Specification SA-280 pending approval of A-315 and inclusion in Tables P-5 and P-7?

Reply: It is the opinion of the Committee that piping complying with ASTM Specifications A 315-47T will meet the intent of the Code under the requirements for the use of piping complying with Specification SA-213, Grade T12.

CASE No. 1073

(Special Ruling)

Inquiry: Is it permissible under the Code to construct a vessel, the tube bundle and heads of which are to be made of pure nickel, using the physical data for wrought material in Specification SB-160 for the cast nickel heads?

Reply: It is the opinion of the Committee that the use of cast nickel heads and tube bundles of a composition comparable to that of Specification SB-160 may be used in the construction of unfired pressure vessels, provided the design includes no welding. For services at temperatures between subzero and 500 F, the maximum design stress shall be 9000 psi.

Proposed Revisions and Addenda to Boiler Construction Code

IT IS the policy of the Boiler Code Committee to receive and consider as promptly as possible any desired revisions of the rules and its codes. Any suggestions for revisions or modifications that are approved by the Committee will be recommended for addenda to the Code, to be included later in the proper place.

The following proposed revisions have been approved for publication as proposed addenda to the Code. They are published herewith with corresponding paragraph number to identify their location in the various sections of the Code and are submitted for criticism and approval from anyone interested therein.

It is to be noted that a proposed revision of the Code should not be considered final until formally adopted by the Council of the Society and issued as pink-colored addenda sheets. Added words are printed in SMALL CAPS; words to be deleted are enclosed in brackets []. Communications should be addressed to the Secretary of the Boiler Code Committee, 29 West 39th St., New York 18, N. Y., in order that they may be presented to the Committee for consideration.

PAR. P-101(**a**) Add the following:

For the attachment of stays or braces by fusion welding, see Par. P-200(**c**).

TABLES P-7 AND U-2 Add the following stresses for Specification SA-315.

Temperatures deg F						
−20 to 650 F	700	750	800	850		
12000	12000	12000	11000	11200		
900	950	1000	1050	1100	1150	1200
10000	8000	5850	3850	2200	1400	900

SPECIFICATION SA-285 Revise footnote[1] to read:

[1]Steel plate TO [under] this specification may BE ORDERED IN COPPER STEEL; WHEN SO ORDERED THE copper content IN SUCH PLATE SHALL NOT EXCEED [not exceeding] 0.35 per cent ON LADLE ANALYSIS.

PAR. H-4 Revise to read:

H-4. The maximum allowable working pressure on the shell or drum of steel-plate steam-heating and hot-water boilers shall be determined [by the strength of the weakest course, computed from the thickness of the plate, the tensile strength stamped thereon, which should be the minimum specified, the efficiency of the longitudinal joint, or of the ligaments between the tube holes in shell or drum (whichever is the least), the inside diameter of the course, and the factor of safety,] IN ACCORDANCE WITH THE FOLLOWING FORMULA. [but] In no case shall A BOILER BE DESIGNED FOR A [the] pressure [on which the factor of safety is based considered] less than 30 lb GAGE.

(The formula and definitions given in Par. H-4 of the Code will be retained.)

TABLE U-3 Add the following stresses covering copper-silicon bolting:

Spec. no. BOLTING	Grade, type, or name	Notes	Spec. min tensile	Temperatures not exceeding deg F: Sub-zero to 150	250	300	350
SB-98	A, C, D-soft	(3)(5)	52000	3000	3000	3000	3000
SB-98	A, C, D-1/2 hard	(3)	70000	7600	7600	7600	7600
SB-98	B-soft	(3)	40000	2400	2400	2400	2400
SB-98	B-1/2 hard	(3)	55000	4000	4000	4000	4000

ASME NEWS

And Notes on Other Engineering Societies

COMPILED AND EDITED BY A. F. BOCHENEK

THE BUSINESS DISTRICT OF PORTLAND, ORE., "CITY OF ROSES." THE ASME 1948 FALL MEETING WILL BE HELD ON THE CAMPUS OF REED COLLEGE WHICH IS FIVE MILES FROM THE CITY

Oregon Section to Be Host at ASME 1948 Fall Meeting, Sept. 7–9

Headquarters: Reed College, Portland, Ore.

HYDROELECTRIC power, forest utilization, and mechanical-engineering problems of interest to the Pacific Northwest will feature the program of the 1948 Fall Meeting of The American Society of Mechanical Engineers to be held at Reed College, Portland, Ore., Sept. 7–9, 1948.

Twenty-six technical papers will be read at 10 sessions sponsored by the following divisions and committees: Power, Hydraulic, Petroleum, Wood Industries, Aviation, Materials Handling, Education, Metals Engineering, and Management.

Accommodations have been arranged for members at one of the Reed College dormitories. Reed College is five miles from the center of Portland. Members who prefer to stay in the city will find reservations available at the Heathman and New Heathman Hotels. Transportation facilities will be provided from the hotels to the College and return for a fee of ten cents each way before and after the sessions.

A feature of the meeting will be a tour to the Timberline Lodge, situated on the slope of Mt. Hood at an elevation of 6000 ft. The tour will include a dinner at the Lodge. A. A. Groening, head, physics department, Lewis and Clark College, Portland, Ore., will speak on "Atoms for Peace."

At the Fall Banquet, to be held on Thursday, Sept. 9, Wilson M. Compton, president, State College of Washington, Pullman, Wash., will be the main speaker.

As part of the women's program, a trip will be made through the Jantzen Knitting Mills. Other social events are being planned by the women's Reception and Entertainment Committees.

Chairmen of the committees in charge of local arrangements for the meeting are:

General chairman, B. G. Dick; Local Finance Committee, E. E. Bartlett; Technical Events, A. A. Osipovich; Printing, George E. Joost; Hotel, E. D. Rowan; Entertainment, F. J. McCanna; Inspection Trips, Mark M. Clayton; Registration, C. G. Tupling; Publicity, P. D. Christerson; Reception, F. L. Davis.

Chairmen of the women's committees are: Entertainment, Mrs. Eugene Caldwell; Reception, Mrs. Bertram G. Dick.

The Tentative Program

TUESDAY, SEPT. 7

8:00 a.m.

Registration

9:30 a.m.

Power (I)—Hydraulic (I)

Portable Gas Turbine Power Plants, by Walter Giger, Mem. ASME, engineer, transportation industries, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

Repairs of Hydro Adjustable-Blade Turbines by Welding, by Joel B. Justin, Philadelphia, Pa., and E. T. Davis, Twin Branch Plant, Indiana-Michigan Electric Company, Mishawaka, Ind.

12:15 p.m.

Luncheon

Opening and Welcoming Ceremonies

2:30 p.m.

Power (II)—Hydraulic (II)

Symposium—Hydropower and the Northwest

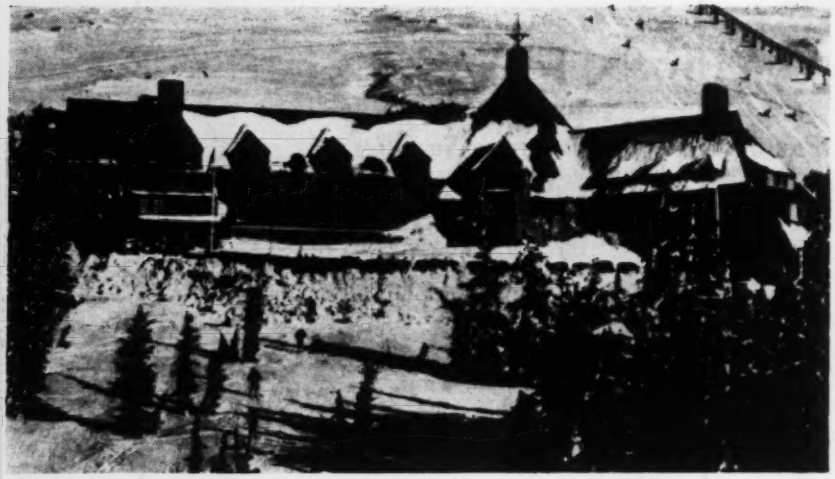
Proposed Program for the Regional Development of the Columbia River, by O. E. Walsh, district engineer, Portland Oregon District, Corps of Engineers, Portland, Ore.

Hydro—The Energy Base of the Northwest, by Paul J. Raver, administrator, Bonneville Power Administration, Dept. of Interior, Portland, Ore.

McNary Hydro-Electric Plant—Preliminary Design, by Kenneth G. Tower, senior hydraulic engineer, Portland Oregon District, Corps of Engineers, Portland, Ore.

Petroleum

Construction of Katy Gas Cycling Plant, by W. T. Robertson, Mem. ASME, design engineer, and H. N. Stamper, assistant chief



TIMBERLINE LODGE, YEAR-ROUND RESORT SITUATED ON THE SLOPES OF MT. HOOD AT AN ELEVATION OF 6000 FT.

(At a dinner meeting at the Lodge, members will hear A. A. Groening, head, physics department, Lewis and Clark College, Portland, Ore., speak on "Atoms for Peace.")

engineer, Humble Oil and Refining Company, Houston, Texas.

5:30 p.m.

Dinner

Historical Bits of Interest on Oregon Section.
Recognition of past chairmen and prominent members of ASME.

7:15 p.m.

Inspection Trip

Reynolds Metal Aluminum Plant, Troutdale, Ore.

WEDNESDAY, SEPT. 8

8:00 a.m.

Registration

9:30 a.m.

Wood Industries (I)

Historical Introduction to Tractor Logging, by Phil Nordling, Hyster Co., Portland, Ore.

Experiments With Mobile Equipment, by A. Zwald, chief engineer, Hyster Company, Portland, Ore., presented by Paul Brainard. (Same company.)

Skyhook; Special Logging Equipment for Use in Inaccessible Places, by P. Grabinski, head of Skyhook department, Pointer Willamette Company, Portland, Ore. (Movie.)

Aviation

Attenuation-Phase Frequency Analysis as Applied to Servomechanisms for Airplane Control Surfaces, by James J. Rahn, research engineer, Boeing Airplane Company, Seattle, Wash.

What Is an Optimum Anti-Icing Design, by Robert L. Berner and T. H. Grieger, layout designer, engineering department, The Glenn L. Martin Co., Baltimore, Md. (Presented by Benjamin F. Ruffner, professor, aeronautical engineering, Oregon State College, Corvallis, Ore.) (48—SA-38 this paper was presented at the 1948 Semi-Annual Meeting.)

Problems in High-Altitude Nutrition, by Hugh H. Darby, department of terrestrial magnetism, Carnegie Institute of Washington, Washington, D. C. (Presented by Title) (Re-presented from 1947 Annual Meeting.)

Materials Handling

Load Grab Attachment for Front Fork-Lift Trucks, by L. Ehmans, experimental engineer, Hyster Company, Portland, Ore.

Development of the Wagoner-mobile Fold-a-Way Lift, by John R. Deffenbaugh, engineer in charge of production control, Mixermobile Manufacturers, Portland, Ore.

12:15 p.m.

Luncheon

Subject: The Engineer's Stake in His Community.

Speaker: L. J. Fletcher, Mem. ASME, director of training and community relations, Caterpillar Tractor Company, Peoria, Ill.

2:30 p.m.

Education

The Liberal Arts College as a Training Ground for Engineers, by Raymond T. Ellickson, professor of physics, Reed College, Portland, Ore.

College-Industry Relations With Particular Reference to Placement and Orientation of Mechanical Engineering Graduates, by Samuel H. Graf, Fellow ASME, professor of mechanical engineering and director, engineering experimental station, Oregon State College, Corvallis, Ore.

Paper by B. T. McMinn, Mem. ASME, professor, mechanical engineering, University of Washington, Seattle, Wash.

Metals Engineering

Stainless Steel Castings, by W. B. Kirby, engineer, Electric Steel Foundry Company, Portland, Ore.

Symposium—Light Metals

Research in the Field of Light Metals in the Industrial Research Division of Washington State College, by W. A. Pearl, Mem. ASME, director, Institute of Technology, State College of Washington, Pullman, Wash.

Applications, Design, and Engineering as Applied to the Uses of Light Metals, by E. B. Parker, Mem. ASME, acting director of industrial research, State College of Washington, Pullman, Wash.

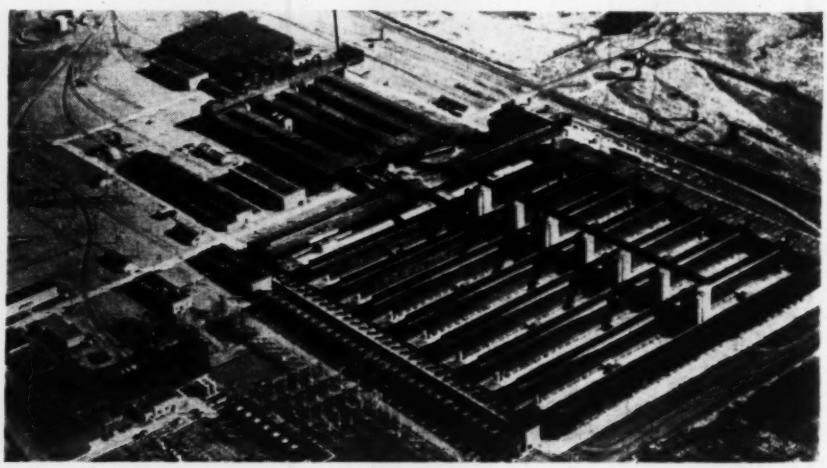
The Magnesium Foundry, by Eugene Cramer, metallurgist, industrial research division, State College of Washington, Pullman, Wash.

The Welding of Light Metals, by Arthur Hard, research engineer, industrial research division, State College of Washington, Pullman, Wash.

5:00 p.m.

Inspection Trip

Tour of Timberline Lodge, Mt. Hood.



ALUMINUM REDUCTION PLANT OF THE REYNOLDS METALS COMPANY, TROUTDALE, ORE., ONE OF THE PLANTS TO BE VISITED DURING THE 1948 FALL MEETING, SEPT. 7–9

6:30 p.m.

Dinner

Timberline Lodge

Subject: Atoms for Peace.

Speaker: A. A. Groening, head, physics department, Lewis & Clark College, Portland, Ore.

THURSDAY, SEPT. 9

8:00 a.m.

Registration

9:30 a.m.

Management

An Application of Control-Chart Technique to Business Estimating, by W. B. Rice, chief statistician, Plomb Tool Company, Los Angeles, Calif.

The Supervisor's Place in Management, by L. J. Fletcher, Mem. ASME, director of training and community relations, Caterpillar Tractor Company, Peoria, Ill.

Human Relations, by W. F. Boyle, vice-president and general manager, Pelton Water Wheel Company, San Francisco, Calif.

Wood Industries (II)

Historical Introduction to Wood Industries Manufacturing, by H. E. Cox, manager, Willamette Valley Office of West Coast Lumbermans' Association, Eugene, Ore.

Technological Advances of Lumber Planing Machines, by Peter Koch, Mem. ASME, mechanical engineer, Stetson-Ross Company, Seattle, Wash.

Integrated Forest Utilization in the Pacific Northwest, by O. H. Schrader, college of forestry, University of Washington, Seattle, Wash.

Investigation of Energy Requirements for Circular Insert-Point Headsaws, by C. J. Telford, forester, and L. H. Reinoke, technologist, Forest Products Laboratory, Madison, Wis.

Results of Accelerated Tests and Long-Term Exposure on Glue Joints in Laminated Beams, by T. R. Truax, technologist and M. L. Selbo, chemical engineer, Forest Products Laboratory, Madison, Wis. (47—A-85. This paper was presented at the ASME 1947 Annual Meeting.)

12:15 p.m.

Luncheon

Speaker to be announced.

2:00 p.m.

Inspection Trip

Bonneville Dam.

7:30 p.m.

Banquet

Toastmaster: Eugene Caldwell, Mem. ASME, consulting management engineer, Portland, Ore.

Subject: Engineering in an Era of Big Science and Big Government

Speaker: Wilson M. Compton, president, State College of Washington, Pullman, Wash.

FRIDAY, SEPT. 10

9:00 a.m.

Tour to Longview, Wash.

Inspection of sawmills, plywood plants, and related industries. Luncheon at Hotel Monticello, Longview, Wash., and dinner "Columbia River Salmon Bake" at Longview, Wash.

Mechanical Engineers Receive ASTM Awards

AMONG the award winners at the annual meeting of the American Society for Testing Materials, held recently in Detroit, Mich., were two junior members of the ASME.

P. R. Toolin, research engineer in the mechanics department of the Westinghouse Research Laboratories, was one of three recipients of the Charles B. Dudley Medal for a paper presented in 1947 on "The High Temperature Fatigue Strength of Several Gas Turbine Alloys."

New ASME Publications Available

THREE new publications have been added to the list of engineering literature published by The American Society of Mechanical Engineers. The first is the proceedings of the 19th National Oil and Gas Power Conference held at Cleveland, May, 1947, and the other two are revisions of engineering standards previously published.

The 1947 Oil and Gas Power Proceedings is a 96-page 8½ × 11-in. booklet containing 11 papers complete with discussion under three subject headings: applications; fuels; and bearings. The papers cover suggestions for use of combustion engines in locomotives, discussions of fuel injection in aircraft engines, smokeless operation of Diesel engines, fundamentals of sleeve-bearing design, and use of aluminum-alloy bearings in Diesel engines. Price of the Proceedings is $3.50.

Cut and Ground Thread Taps (ASA B5.4—1948) is a revision of the standard published in 1939. New sizes and styles of taps have been added and old styles no longer in demand have been dropped. A new 1/16-in-size tap has also been added to the pipe-tap dimensional tables. The standard gives thread dimensions and working tolerances for various types of taps and a glossary of tap terminology and definitions. Price per copy is $1.50.

Spindle Noses for Tool Room Lathes, Engine Lathes, Turret Lathes, and Automatic Lathes (ASA B5.9—1948) is a revision of a 1936 standard. The new standard discontinues Type C spindle noses and introduces two smaller sizes of Types A, B, and D spindle noses as well as one large size of Types A and B. Dimensions and tolerances for five sizes of Type L spindle noses have been added as an allowable standard for engine lathes. The standard gives dimensions for spindle noses, backs of mating chucks, and spindle fixtures as well as approved dimensions of gages for checking spindle noses.

While the standard was originally developed for various types of lathes, it can be used wherever chucks or fixtures have to be mounted accurately and rigidly on revolving spindles. Price per copy is 85 cents.

These publications may be ordered from ASME Publications Sales-Department, 29 West 39th Street, New York 18, N. Y.

August News High Lights

THE ASME 1948 Fall Meeting in Portland, Ore., (705) and two conferences are on the calendar for September. The Aviation Conference at Dayton, Ohio, will give over its second day to a tour of laboratory facilities at Wright Field and to flight-test demonstrations of American fighting aircraft (716). Two technical sessions and a luncheon at which President Bailey will speak are the contributions of the ASME Industrial Instruments and Regulators Division to the Third Instruments Conference at Philadelphia, Pa. (718).

The 50th anniversary of the Diesel engine in America was marked by the Oil and Gas Power Division at its annual conference held at St. Louis, Mo., May, 1948 (717).

For photographs and biographies of ASME 1948–1949 nominees see pages 709 to 712. Check over proposed amendments to ASME Constitution and changes to the By-Laws and Rules (714).

In recognition of its leadership in the field of petroleum mechanical engineering, professional-division status was conferred by Council on the Petroleum Committee of the Process Industries Division. (717)

A gift honoring James Alward Seymour has been established as the Seymour Memorial Fund, which will be administered by the "Old Guard" for the benefit of student and junior members (708).

Distinguished members of the ASME and the Armed Forces were present at a brief ceremony at which George C. Marshall, Secretary of State, was presented a certificate of honorary membership in the Society (719).

C. J. Freund, Mem. ASME, is the new president of the American Society for Engineering Education (719).

A Spanish edition of Section I of the ASME Boiler Construction Code is now available as an instrument of safety for use in Latin-American countries. (708) Honorary membership on the Boiler Code Committee was conferred on two veterans of the Committee. (708)

Recognition by the press of the prestige of the Society is reflected in the record count of clippings from newspapers and periodicals covering the ASME 1947 Annual Meeting. (719)

Seymour Memorial Fund to Be Administered by "Old Guard"

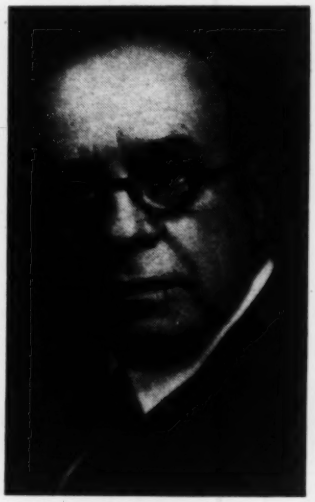
STUDENT and junior members of The American Society of Mechanical Engineers will be the principal beneficiaries of a gift of $5000 recently presented to the ASME for the establishment of the Seymour Memorial Fund.

The gift was made by Marian S. Seymour, wife of the late James Alward Seymour, as a memorial to her husband, designer and engine builder, who during his long membership in the Society took special interest in the welfare of its younger members.

According to the deed of gift, the fund "is to be administered by the Dues-Exempt Committee of the 'Old Guard' for the benefit of the members of the Society with special emphasis on junior and student members."

Mr. Seymour was an honorary member when he died in 1943. His company, the McIntosh & Seymour Engine Corporation of Auburn, N. Y., had a world-wide reputation as builders of some of the largest and finest reciprocating steam engines used in central-station service. The three units representing the high-water mark in efficiency of this type were installed in the Redondo plant of the Pacific Light and Power Company near Los Angeles, Calif. They were 5000-kw cross-compound horizontal-vertical type with cylinders 34 in. and 70 in. diameter × 56 in. stroke, direct-connected to the generator with speed of 100 rpm, steam pressure 175 psi, superheat 100 F. Two years after completion, this type of engine was doomed by the advent of the steam turbine with its increased economy and greatly reduced size.

With the collapse of the large reciprocating-engine business, Mr. Seymour turned his attention to building Diesel engines. In 1915 he was awarded a gold medal at the Panama-Pacific Exposition for design of regulating devices for Diesel engines. During the first World War he aided the government in the development of Diesel engines for submarines.



JAMES ALWARD SEYMOUR IN WHOSE HONOR THE SEYMOUR MEMORIAL FUND HAS BEEN ESTABLISHED

(The Fund, a gift of $5000, is to be administered by the Old Guard for aid of junior and student members.)

Mr. Seymour was a man of great personal charm with a seemingly limitless capacity for friendships. He joined the Society in 1892 and was elected an honorary member in 1940. His interest in young men made him one of the enthusiastic members of the Old Guard, a group of 400 dues-exempt members who elect to continue voluntary payment of dues to a fund set aside for the aid of young engineers. It is appropriate, therefore, that a committee of the Old Guard, most of whom are friends of his, should be called upon to administer a fund established in his honor.

Because of this fund, student members are aided in participating in Society activities while still at the universities. The Old Guard pays traveling expenses of student prize winners to the Annual Meeting so that they can receive the prizes in person and attend the banquet as guests. The Student Luncheon, a regular feature of the Annual Meeting, also is made possible by its initiative and contributions.

Metropolitan Section Fall Review Courses

THE Metropolitan Sections of the ASME and the AIEE announce the fall program of Review Courses designed to prepare engineers for New York and New Jersey professional engineer's license examinations.

The following courses will be given: Engineering Economics and Practice, Structural Planning and Design, Effective Speaking, Mechanical Engineering, Electrical Engineering and Applications, and Basic Engineering Sciences.

Courses commence Sept. 8, 1948.

For folder write to The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y.

Boiler Code Committee Appoints Honorary Members

IN the presence of 68 members and guests of the Boiler Code Committee who were gathered at Echo Lake Country Club, Westfield, N. J., June 24, 1948, for their annual social event, President Bailey conferred on C. W. Obert, member ASME, and James Partington, member ASME, certificates of honorary membership in the Committee, in recognition of their long and faithful services to the cause of boiler safety.

Active in the Boiler Code Committee since its inception, Mr. Obert served as secretary when the Committee was originally appointed in 1911. In this capacity, he handled the editorial work in connection with the preparation of the first edition of the Code. When, in 1927, he became associated with the Union Carbide and Carbon Research Laboratories, he retired from the secretaryship which he had held for fifteen years. Arrangements were made through his company, however, which made it possible for him to devote part of his time to the work of the Boiler Code Committee, acting as its honorary secretary. He was also appointed to membership in the Committee in 1927, retaining that position until he was made an honorary member in January, 1948.

In addition to these activities, Mr. Obert is a member of the Subcommittee on Coordination and chairman of the American Welding Society's Conference Committee on Welding and of the ASME Special Committee on Low-Temperature Vessels. He has been an active member of the Executive Committee of the Boiler Code Committee for many years.

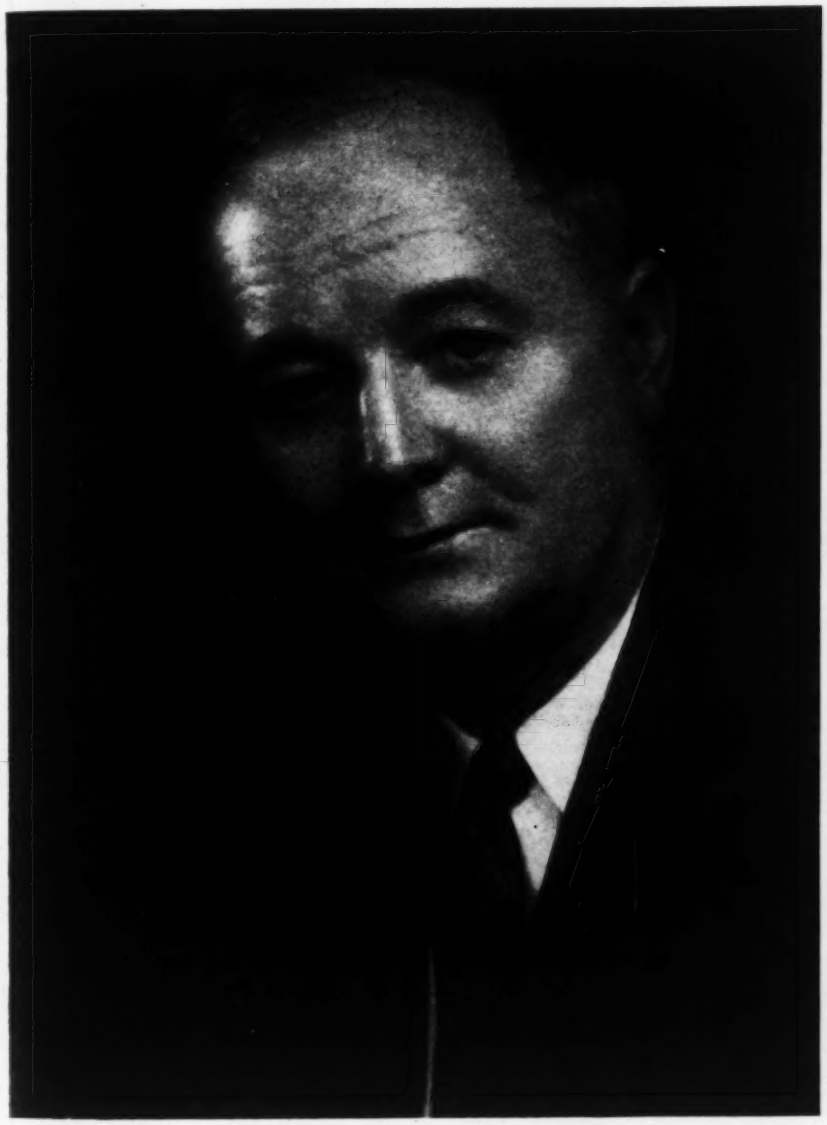
Mr. Partington was appointed a member of the Boiler Code Committee in 1924, and has served as member and chairman of the Subcommittees on Welding and Boilers of Locomotives since 1925. He was appointed to the Executive Committee in 1925, serving until he resigned his membership in the main Committee in 1947. Mr. Partington has been a valuable member of several other committees dealing with miniature boilers, materials, and rules for inspection.

Spanish Edition of the ASME Power Boiler Code

THROUGH the efforts and co-operation of the American Boiler and Affiliated Industries, the Society has just published a Spanish translation of the ASME Power Boiler Code (Section I of the ASME Boiler Construction Code). Through Capt. J. N. Parrott, the assistance of the Inter-American Safety Council was also made available in connection with the editorial work of this special edition of the Code and its distribution to the interested parties.

The main objective at which the Society aims in preparing this translation is to interest the industries in 20 Latin-American republics to work with their governments in order to secure laws which require proper construction and regular inspection of their boilers. It is also hoped that the translation will aid industrialists in South American countries in the proper care and inspection of boilers. Three serious boiler explosions in Latin America have been reported recently, in which adults and children lost their lives due to a lack of safety guidance.

Copies of the Spanish edition of the ASME Power Boiler Code are available from the ASME, 29 West 39th St., New York 18, N. Y., at $5 each.



James Mulherrin Todd

Nominated for President

ASME OFFICERS *Nominated for* 1948–1949

DURING the Meeting of The American Society of Mechanical Engineers in Milwaukee, Wis., May 30–June 5, 1948, James M. Todd, consulting engineer, 217 North Peters St., New Orleans, La., was nominated by the National Nominating Committee for the office of President of the Society for the year 1948–1949.

Regional Vice-Presidents named by the Committee to serve two-year terms on the Council of the ASME were A. R. Mumford, New York, N. Y. (renomination), Arthur Roberts, Jr., Lynchburg, Va.; Forrest Nagler, Milwaukee, Wis.; and Carl J. Eckhardt, Austin, Texas.

Directors at Large named by the Committee to serve a four-year term on the Council were J. A. Keeth, Kansas City, Mo., and Ralph A. Sherman, Columbus, Ohio.

Members of the Committee making the nominations were: L. C. Smith, Hartford, Conn., representing Region I; R. W. Flynn, New York, N. Y., representing Region II; F. S. Erdman, Ithaca, N. Y., representing Region III; Paul R. Yopp, Atlanta, Ga., representing Region IV; H. S. Colby, Cleveland, Ohio, representing Region V; H. L. Solberg, secretary Lafayette, Ind., representing Region VI. D. A. Elkins, Salt Lake City, Utah, representing Region VII; and Orval L. Lewis, Tulsa, Okla., representing Region VIII.

Election of ASME officers for 1948–1949 will be held by letter ballot of the entire membership, closing September 28, 1948.

Biographical sketches of the nominees follow on the succeeding pages.

Nominated for President

James Mulherrin Todd

JAMES MULHERRIN TODD, who has been nominated to serve for one year as President of the ASME, was born in St. Mary Parish, La., May 25, 1896. Upon graduating from the College of Engineering at Tulane University in 1918, he enlisted for service in World War I, and was sent abroad to England and France as an officer in the Engineer Corps.

In 1919 his first civilian employment was with Penick and Ford as chief engineer of their Marrero, La., plant. This was followed by service as assistant engineer in consulting practice until 1923 when he joined the engineering staff of A. M. Lockett and Company. In 1928 he began private practice as a consulting mechanical and electrical engineer. In 1930 Mr. Todd was given the graduate degree in mechanical engineering by Tulane University. He is a member of Beta Louisiana Chapter of Tau Beta Pi.

Mr. Todd served on the board of the Louisiana Engineering Society for six years, and as president of that society for the year 1930. He has also been a member of the membership committee and public-relations committee of that society for the past eighteen years.

In 1922 Mr. Todd joined the ASME as a junior member, and in 1929 was elected a full member. He was manager of the Society from 1933 to 1936, vice-president from 1936 to 1938, and was elected to the grade of Fellow in 1944. He served as chairman of the New Orleans Section for three years; as a member of the Local Sections Committee, and as chairman of that Committee for two years. He has been a member of the Society's Registration Committee, Committee on Economic Status of the Engineer, chairman of the Membership Committee in Region VIII for the past two years, and a member of the Board on Honors, serving as chairman of that Board for the current year. He organized student branches of the Society at Tulane and Louisiana State Universities, and visited on behalf of the Society, many of the student branches in Group IV and Region VIII. He organized the New Orleans Section of the AIEE, serving as its first chairman, and is still active in AIEE affairs in the New Orleans area.

During World War II Mr. Todd handled the mechanical and electrical problems in connection with airfields, shipyards, and other important defense work for the Army, Navy, and Maritime Commission. He organized and served as first president of The Officers Town House in New Orleans—a facility for the Commissioned Personnel of the Armed Forces.

As vice-president and member of the board of The Jefferson Lake Sulphur Company, in charge of engineering, Mr. Todd has had mining assignments in Mexico, and Central and South America, and is recognized as one of the leaders in the mining and production of crude sulphur.

He is licensed to practice mechanical and electrical engineering in the states of Alabama, Mississippi, and Texas, and has had a part in the effort to bring professional registration for mechanical and electrical engineers to Louisiana. Mr. Todd maintains an engineering office specializing in air-conditioning, power plants, the equipment of large buildings and industrial plants, and has been responsible for the design and installation of many of the important installations in the New Orleans and Houston areas. He is at present a member of the Board of Standards and Appeals—the administrative agency for the building code of the city of New Orleans.

Mr. Todd is an Episcopalian, and a member of prominent clubs in his city.

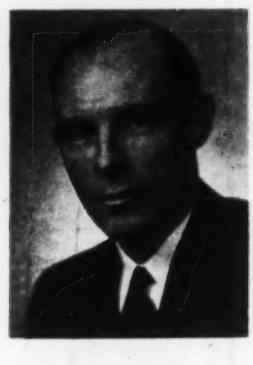
Nominated for Regional Vice-Presidents

To Serve Two-Year Term

A. R. MUMFORD

ARTHUR ROBERTS, JR.

FORREST NAGLER



CARL J. ECKHARDT

Albert Russell Mumford

ALBERT RUSSELL MUMFORD, who has been renominated from Region II to serve for two years as Regional Vice-President of The American Society of Mechanical Engineers, was born in Boston, Mass., July 13, 1895. He was graduated from the Massachusetts Institute of Technology in 1918 with the degree of BS in electrochemical engineering. In April, 1918, he enlisted in the U. S. Naval Reserve Forces and was assigned to work in the Construction Division at the Charleston Navy Yard. After the Armistice he became a junior marine engineer with the U. S. Shipping Board, and later was licensed as 2nd assistant engineer. While with the Shipping Board he had charge of a group of petty officers sent to Erie, Pa., to co-operate with the U. S. Bureau of Mines on the testing of the Emergency Fleet Corporation's water-tube boiler.

In March, 1919, Mr. Mumford became assistant fuel engineer of the U. S. Bureau of Mines at Pittsburgh, Pa., under Henry Kreisinger, and remained there until May, 1923. During this period extensive investigations of the use of fuel in marine water-tube and fire-tube boilers were carried on. In May, 1923, Mr. Mumford became research and design engineer for the New York Steam Corporation and remained until October, 1938. During this period studies of combustion of anthracite on chain-grate stokers were made. The Kips Bay Station of the New York Steam Corporation was designed and built during this period. In October, 1938, he became associate director of research for the Consolidated Edison Company of New York and was with that company until February, 1942. During this period research was continued on the problems of steam utility, and new projects on heat absorption in furnaces undertaken. In February, 1942, he became development engineer for Combustion Engineering Company, Inc., New York, N. Y.

Mr. Mumford became a junior member of the ASME in 1919 and passed successively through the grades of associate member and member to life member in 1942. He has served on the Program and Executive Committees of the Metropolitan Section of which he was chairman in 1940–1941. He was chairman of the Executive Committees of the Fuels Division and Library Board, and served as secretary of the National Nominating Committee.

He was speaker at the Group Delegates Conference in 1941, chairman of the Special Research Committee on Furnace Performance Factors since 1941, and was a member of the Committee on Sections, 1942 to 1947. He has been a member and chairman of several technical and administrative committees of the National District Heating Association, elected director, May, 1948, and chairman of the Technical Advisory Committee on Corrosion, of the American Society of Heating and Ventilating Engineers. He was a member of Committee D-5 of the American Society for Testing Materials.

He is a Fellow of the American Association for the Advancement of Science. Mr. Mumford served as vice-president of the Board of Education in Bogota, N. J.

He has contributed many papers and discussions to the technical literature through the Bureau of Mines, the ASME, the NDHA, the ASHVE, and through the technical press.

Arthur Roberts, Jr.

ARTHUR ROBERTS, JR., who has been nominated from Region IV to serve for two years as Regional Vice-President of The American Society of Mechanical Engineers, was born at Radford, Va., Sept. 3, 1902. He attended the Radford High School, and was graduated from Virginia Polytechnic Institute in 1924, with a degree of BS in mechanical engineering, and an ME degree from the same institution in 1925.

After spending two years in the industrial field, he was employed by the Lynchburg Foundry Company, Lynchburg, Va., in 1927. He served at both the company's plants in Lynchburg and Radford, Va., in the capacities of estimator, master mechanic, head of the time-study department, assistant plant manager, chief estimator, and on March 1, 1936, he was appointed chief engineer in the engineering department, which position he still holds.

Mr. Roberts is the author of articles published in *Southern Power and Industry*, and *Foundry*. He is a past-president of the Lynchburg Kiwanis Club, a member of the Chamber of Commerce, Lynchburg, Va., a steward of the Court Street Methodist Church, and president of the Friendship Bible Class of that church.

In 1936 Mr. Roberts became a junior member of the ASME, and in 1940 was elected to full membership. He was elected chairman of the Virginia Section in 1945, after serving that Section in various capacities. He has been a delegate to the Regional Administrative Committee meeting, the Group Delegates Conference, has served as secretary to the Regional Vice-President, and in 1947 was chairman of the National Agenda Committee.

Forrest Nagler

FORREST NAGLER, who has been nominated from Region VI to serve for two years as Regional Vice-President of The American Society of Mechanical Engineers, was born in Freeport, Mich., in 1885. He received his BS in mechanical engineering from the University of Michigan, specializing in hydraulic and marine engineering. In 1906 he joined the Allis-Chalmers Manufacturing Company where he was employed as a graduate student in the foundry and machine shop.

From that time until 1930 he remained with that company, principally on hydraulic power work. In 1930 he went with the A. O. Smith Corporation, Milwaukee, Wis. in engineering and research fields. From 1933 to 1941 Mr. Nagler was chief engineer with the Canadian Allis-Chalmers, Limited, Toronto, Ontario, Can. In 1942 he returned to the United States as chief mechanical engineer with the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., in which capacity he serves at the present time.

During the recent war Mr. Nagler's principal assignment was in connection with the production of the heavy machinery used for producing the atomic-bomb material. This work was concluded with a trip to witness the second or underwater burst at Bikini.

He is the inventor of the Nagler type of axial-flow high-speed hydraulic-turbine runner and a contributor to the technical press and engineering journals. He served three years in the First Wisconsin Cavalry, has specialized in rifle shooting, and is the author of technical books on archery and its application to big-game hunting.

Mr. Nagler became a member of the ASME in 1918. He was a member of the Hydraulic Division, Executive Committee 1937–1938, and chairman of that committee 1939–1940. He was also a sponsor of the Committee on Hydraulic Prime Movers. In 1921 Mr. Nagler was awarded a life membership for distinguished service, for the best paper presented before the Society, entitled "A New Type of Hydraulic-Turbine Runner," which was published in ASME Transactions, vol. 41, 1919. He is also a member of ASCE, and the Triangle and Pi Tau Sigma fraternities.

Carl John Eckhardt

CARL JOHN ECKHARDT, who has been nominated from Region VIII to serve for two years as Regional Vice-President of The American Society of Mechanical Engineers, was born in Yorktown, Texas, Oct. 28, 1902. He was educated at Brackenridge High School, San Antonio, Texas, and at The University of Texas, Austin, Texas, from which he received the degree BS ME in June, 1925.

In 1925–1926 he served the Westinghouse Electric and Manufacturing Company in its South Philadelphia plant, as a graduate student. In 1926 he became a member of the teaching staff of The University of Texas as instructor of mechanical engineering and from that university he received his master's degree in mechanical engineering in 1930. From 1929 to 1936 he was adjunct professor of mechanical engineering at his alma mater, as well as superintendent of power plants for the university. From 1936 to the present time he has been professor of mechanical engineering and superintendent of utilities at the university. In the latter capacity Professor Eckhardt has designed, conducted the negotiations for, supervised the installation of, operated and maintained the utilities of The University of Texas.

Since 1934 Professor Eckhardt has contributed articles to many technical magazines, among them, *Combustion*, *Southern Power Journal*, *Heating and Ventilating*, and *Southern Power and Industry*.

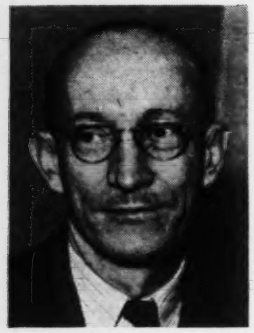
In 1929 he joined the ASME as a junior member, and became a member in 1937. He was honorary chairman of the ASME student branch of The University of Texas in 1939, and chairman of the South Texas Section in 1946. He was a delegate to the Regional Delegates Conference in 1946, and Speaker of that Conference in 1947. Professor Eckhardt is also a member of Sigma Xi, Tau Beta Pi, and Pi Tau Sigma. He is at the present time chairman of the Committee on Student Selection and Guidance of the Engineers' Council for Professional Development.

Nominated for Directors at Large

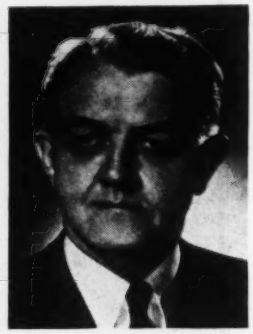
To Serve Four-Year Terms

J. A. Keeth

J. A. KEETH, who has been nominated for the Office of Director at Large of The American Society of Mechanical Engineers, to serve a four-year term, was born in Colorado Springs, Colo., March 23, 1897, and attended grade school and high school in that city. He attended Carnegie Institute of Technology, and Armour Institute of Technology, receiving a BS degree in mechanical engineering from the latter in 1919, after a brief interruption caused by service in the Army in World War I. On completion of his college course, he was employed in the production department of the Kansas City Power and Light Company in Kansas City, Mo., and has remained in the employ of that company. He has served successively as draftsman, construction inspector, design engineer, assistant to the superintendent of production, and since 1938 has been manager of power production. During that period of service, he has been intimately connected with the development of a power system that originally owned and operated one generating station of 17,000 kw capacity in 1919 to one



J. A. KEETH



RALPH A. SHERMAN

that now operates over 300,000 kw of plant capacity and is a part of an integrated system of nearly 600,000 kw. He participated in the design and construction of the plant facilities of the Panhandle Power and Light Company, a utility organized for the primary purpose of serving the new oil industry in the Panhandle of Texas. During its period of operation under the management of the Kansas City Power and Light Company, three generating stations were constructed with a total capacity of about 45,000 kw. During his 29 years with the Kansas City utility, he has participated in the pioneering of many power-plant features that have today become commonplace. These included the first central-station use of air preheaters, one of the three first users of the 1250-psi reheat topping cycle, use of pulverized petroleum coke, combination use of natural gas and chain-grate coal firing.

Mr. Keeth became a junior member of the ASME in 1919, an associate member in 1925, and a member in 1931. He was made a Fellow of the Society in 1947. He is a charter member of the Kansas City Section, having served as secretary of that Section in 1926 and 1927, vice-chairman in 1931, and chairman in 1932. He became a member of the Committee on Sections in 1940 and served until that committee was disbanded in 1946. He also served six years on the Power Division Executive Committee, and is now completing two years of service as chairman of the Group VIII Regional Executive Committee.

Among the other technical societies of which Mr. Keeth is a member are Tau Beta Pi, The Engineers' Club of Kansas City, the Missouri and National Society of Professional Engineers, the Electric Association of Kansas City and the Prime Movers Committee of the Edison Electric Institute in which organization he has served both as secretary and chairman. He has served on special city committees dealing with smoke ordinances and operating engineer licenses.

Mr. Keeth has been the author of a number of technical articles which have appeared in various American publications and one foreign publication.

Ralph A. Sherman

RALPH A. SHERMAN, who has been nominated for the office of Director at Large of The American Society of Mechanical Engineers to serve a four-year term, is a native of Iowa. He received his BA degree from the University of Iowa in 1920. Prior to graduation, he spent a year and a half with the Bureau of Mines in Washington, D. C., and Pittsburgh, Pa., and another year and a half in the Army Signal Corps during World War I. Following graduation, he returned to the Fuels Utilization Section of the Bureau of Mines at the Pittsburgh Station. Here he was engaged in research on the application of fuels to marine boilers, blast furnaces, and domestic heating appliances, and conducted an extensive survey on the relation of fuels to the failure of refractories in boiler furnaces.

Mr. Sherman is known in the engineering profession as one of the country's leading authorities on fuels technology, having been identified with the field for nearly thirty years. At Battelle Institute, Columbus, Ohio, with which he has been associated since 1930, he is the assistant director responsible for the Institute's research in fuels technology and production engineering.

Although long recognized for his engineering accomplishments, Mr. Sherman's academic major was chemistry and his degree from the University of Iowa is in that subject. Engineers, generally, look upon him as an engineer, while chemists continue to claim him as a chemist. Last year the Chicago Section of the American Chemical Society dubbed him one of the ten ablest chemists working in the United States in the field of gas and fuel chemistry, following a poll of readers of its publication "The Chemical Bulletin."

Mr. Sherman's accomplishments in fuels technology at Battelle are known to almost anyone who has scanned the editorial pages of engineering publications. He is the author or co-author of about a hundred papers and articles in the field of fuels technology and utilization.

He organized and put into effect the program of research on the utilization of coal that has made Battelle the focal point of research in coal technology.

During the war years Mr. Sherman served as a member of the National Fuel Efficiency Council. In 1946–1947 he headed the Mayor's Advisory Board on Smoke Abatement in Columbus, Ohio.

He became an associate member of the Society in 1924, and was elected a member in 1930. He has a long record of service with the Society as member of the ASME Model Smoke Law Committee, and the Research Committee on Furnace Performance Factors, of the Power Test Code Committee, and chairman of the Power Test Code Committee No. 3 on Fuels. He was chairman of the Fuels Division Executive Committee in 1934 and 1935, and still serves as an associate. He was for ten years, 1930–1940, a member of the Special Research Committee on Boiler Furnace Refractories, and was general chairman of the Joint Fuels Meeting of ASME-AIME, held in Columbus in 1939. He was elected to receive the Percy Nicholls Award for 1948.

His other affiliations include the American Institute of Mining and Metallurgical Engineers, the American Society for Testing Materials, the American Society of Heating and Ventilating Engineers, the American Gas Association, the Society of Naval Engineers, the Railway Fuel and Traveling Engineers' Association, the American Coke and Coal Chemicals Institute, the Institute of Fuel, and Sigma Xi, honorary scientific society. He is active in a number of committees of these societies, serving as chairman of several.

Actions of the ASME Council

At Meetings Held at Milwaukee, May 30 and 31

THE Council of The American Society of Mechanical Engineers met in two sessions during the 1948 Semi-Annual Meeting at the Schroeder Hotel, Milwaukee, Wis., May 30 and 31, 1948.

Present at one or both of these sessions were: E. G. Bailey, president; A. D. Bailey, E. W. O'Brien, D. Robert Yarnall, A. A. Potter, past-presidents; J. Calvin Brown, P. B. Eaton, F. M. Gunby, Linn Helander, T. S. McEwan, A. R. Mumford, T. E. Purcell, E. E. Williams, vice-presidents; J. B. Armitage, W. A. Carter, E. J. Kates, and W. M. Sheehan, directors at large; F. W. Miller and H. H. Snelling (Constitution and By-Laws); R. L. Goetzenberger, (Board of Education and Professional Status); C. B. Peck (Board on Technology); R. W. Flynn and L. G. Haller (Nominating); P. T. Onderdonk (Organization of Engineering Profession); Sebastian Judd, G. V. Minnberger, T. A. Wetzel, F. W. Wiethofer, and H. L. Heywood (Junior observers); M. C. Abrahm, E. W. Allardt, W. L. Betts, E. R. Birkicht, C. A. Davis, R. E. Gallatin, H. F. Gauss, Charles Haggerty, Harold A. Johnson, J. A. Keene, D. E. Kehoe, S. J. Mackenzie, K. J. Mosher, C. H. Shumaker, and E. H. Walton (Regional delegates); J. G. Evans, Horace A. Johnson, Rudolph Michels, Arthur Roberts, Jr. (Guests); C. E. Davies, secretary; and R. A. O'Brien, O. B. Schier, and A. F. Bochenek, staff.

1948–1949 Budget

Following a review, a statement of policies, an estimate of income, and a budget of ex-

penditures for 1948–1949 were approved. These were published on pages 647 and 648 of the July issue of MECHANICAL ENGINEERING.

1949 Semi-Annual Meeting

Upon recommendation of the Executive Committee, San Francisco, Calif., was approved as the location of the 1949 Semi-Annual Meeting.

Board on Membership

Following a discussion of the delegation of the Council's authority to the Board on Membership to act on election and transfer of members, it was agreed that a change in the Constitution would be required to permit this delegation of authority to the Board and that the Council should retain its function of electing and transferring members.

Amendments to Constitution

After a reading of the following amendments to the Constitution, it was voted to submit them to the Business Meeting for approval: Articles C3, Section 1 (Membership). C7 Section 5 (Election of Officers and Directors); C11 Section 2 (Sections); and C15, Section 1 (Professional Practice). The amendments which are published on page 714 of this issue, will be submitted in a letter ballot to the vote of the membership.

Amendments to By-Laws

After a second reading of the following amendments to the By-Laws, it was voted to adopt the amendments as read: Articles B3, paragraphs 2–4 (Membership); B4, paragraphs 2–8 (Qualifications for Admission); B6A, paragraph 19 (Boards and Committees); and B15, paragraph 1 (Professional Practice).

The following proposed amendments of the By-Laws received first reading: Articles B6A, paragraphs 2, 12, and 15 (Boards and Committees); B9, paragraphs, 1, 2, and 5 (Meetings of the Society); B13, Paragraph 1 (Publications and Papers); and B16, Paragraphs 3–6 (Amendments). These amendments are published on pages 714 of this issue.

Amendments to Rules

Amendments to the following Rules were approved: Articles R3, rule 2 (Membership); R10, rules 1, 3, 4, 9, and 11 (Professional Divisions and Groups); R14, rules 2–4 (Funds); and R15, rules 1 and 2 (Professional Practice). See page 714 for a full account of these amendments.

Regional Delegates Conference

Following a report by S. T. Mackenzie, speaker, 1948 Regional Delegates Conference, on the discussions and recommendations of the Conference, it was voted to refer the recommendations to the ASME Committees concerned and to await their reports before taking further action.

The Secretary was directed to send to all regional delegates an expression of appreciation on behalf of members for services rendered to the Society.

Organization of Engineering Profession

Following a long discussion of the organization of the engineering profession during which it was agreed that a need exists for a national over-all engineering organization and that the Engineers Joint Council, though weak in some respects was a useful agency, the following resolutions submitted by the Regional Delegates Conference were accepted:

(1) That the Regional Delegates Conference recommends that the Council propose to continue efforts toward the organization of a national engineering council to co-ordinate the activities of the societies at the local, state, and national levels to speak for engineers, and the profession in matters of broad significance.

(2) That this Body (Regional Delegates Conference) suggest to Council that before any effort is made toward the active formation of an over-all national society the aims and purposes of such a society be clearly defined, the desires of the individual members of the present societies be consulted, and the basis upon which such an over-all society can be effectively sold to the membership of the present societies be determined. If such an organization is formed, among its fundamental aims should be the improvement of the political and economic status of the engineering profession.

Actions of the ASME Executive Committee

A MEETING of the Executive Committee of the Council was held in the Schroeder Hotel, Milwaukee, Wis., May 30, 1948. There were present: E. G. Bailey, president; F. M. Gunby, T. E. Purcell, of the Executive Committee; J. B. Armitage, P. B. Eaton, Linn Helander, E. J. Kates, T. S. McEwan, A. R. Mumford, E. W. O'Brien, W. M. Sheehan, D. Robert Yarnall, of the Council; S. R. Beitler, guest; and C. E. Davies, secretary.

Glossary Committee

Upon recommendation of the Nuclear Energy Application Committee and the Organization Committee, establishment of a Joint Review Board for a Glossary of Nuclear-Energy Terms was approved.

Publication for Foreign Members

Following a report of comments on the new publications plan from members residing in England and South Africa, the secretary was instructed to prepare an appraisal of the values given by the Society to over-seas members, for consideration at a future meeting.

Applied Mechanics Reviews

It was reported that three issues of Applied Mechanics Reviews have appeared. Present subscribers number 1790. The first period ending in 1948 will show a favorable balance, because of financial support of outside agencies, but additional support is needed for 1949.

1949 Spring Meeting

Upon recommendations of the Meetings Committee and the Board on Technology, the 1949 Spring Meeting to be held in New London, Conn., April 25–27, 1949, was approved.

Petroleum Division

Approval by the Board on Technology of the reorganization of the Petroleum Committee of the Process Industries Division as the Petroleum Division was noted. For a story of this reorganization, see page 717 of this issue.

Co-Ordination of National Meetings

Because attendance at ASME meetings often suffers as a result of conflicting meetings of other national engineering societies, it was voted to request the Engineers Joint Council to establish some form of clearing house for national engineering-society meeting and conference dates.

Certificates of Award

Certificates of Award were approved for the following: L. W. Wallace, for five-years service on the Medals Committee and six-years service on the Board of Honors; James A. Gish and Roy H. Porter, Anthracite Lehigh Valley Section; Albert B. Eckerstrom, C. E. Harrington, and Paul E. Mohn, Buffalo Section; Charles A. Davis, Central Illinois Section; Sidney T. Mackenzie and Merwyn C. Randall, Philadelphia Section; Arthur M. G. Moody, Joseph P. Clark, and Hans Gartmann, Trenton Sub-Section.

National Management Council

Letter-ballot approval of the proposed incorporation of the National Management Council was confirmed. A loan from the Society's Development Fund to aid in meeting the first-year costs of the NMC program of encouraging broader American participation in international problems, was approved.

Completion of Survey

It was voted to recommend to the U. S. Department of State that the survey of engineering education in Latin America, started in 1945 by S. S. Steinberg, be completed. The Department of State is to finance the project.

Hodgkinson Fund

On behalf of the Society an expression of appreciation was voted to Francis Hodgkinson, Hon. Mem. ASME, for an unrestricted gift of $956, designated as the Hodgkinson Fund.

Death of W. S. Knudsen

The death of William S. Knudsen, Hon. Mem. ASME, on April 27, 1948, was noted with regret.

Appointments

The following appointments were approved: J. Harland Billings, annual meeting Section M, American Association for the Advancement of Science; J. Calvin Brown, inauguration of president, University of California; Alex D. Bailey, Gano Dunn, A. G. Pratt, and Harry A. Winne, Thomas A. Edison Foundation, Inc.; Robert L. Nugent, inauguration of president, University of Arizona.

L. E. Jermy, inauguration of president, Case Institute of Technology; William McCandless, inauguration of president, University of Toledo. H. B. Maynard, centennial, Société des Ingenieurs Civils de France; and S. B. Crary, International Conference on Large Electric Systems.

Proposed Amendments to ASME Constitution, By-Laws, and Rules

THE following amendments to the Constitution, By-Laws, and Rules of The American Society of Mechanical Engineers, proposed by the Constitution and By-Laws Committee, were approved by the Council on May 31, 1948, and the Business Meeting of corporate members on June 1, 1948, at the Schroeder Hotel, Milwaukee, Wis. The amendments to the Constitution will be submitted to the vote of members in a letter ballot early this month. A vote of the membership is not necessary for amendments to By-Laws or Rules. Most of the amendments to By-Laws and Rules are of a minor nature and have been proposed to make numbering and terminology consistent throughout the Constitution.

Amendments to Constitution

(1) Art. C3, Sec. 1. The corporate membership shall consist of Fellows, Members, Junior Members, *and Honorary Members when elevated from a corporate grade.*[1] In addition there shall be Honorary Members, Associates, and Student Members.

(2) Art. C7, Sec. 5. The Council shall have power to fill vacancies in its membership by appointment until the next election, except that *in filling the office of President, the Council shall choose the Vice-President having the longest consecutive service as Vice-President. In case two or more have equal length of consecutive service as Vice-President, the one shall be chosen,* who is senior by length of corporate membership in the Society.

(3) Art. C11, Sec. 2. The Sections shall be associated into geographical groups with annual meetings at which each Section shall be entitled to representation. Each geographical group shall be entitled to representation in a subsequent conference of group representatives *to be held annually.*

[1] Italicized words indicate changes of present wording.

(4) Art. C15, Sec. 1. In all professional and business relations the members of the Society shall be governed by the *Canons of Ethics for Engineers* incorporated in the By-Laws. (The Canons of Ethics for Engineers was published in full on pages 379 and 380 of the April, 1948, issue of MECHANICAL ENGINEERING.)

Amendments to By-Laws

(1) Art. B3, Par. 2 (New). A corporate member elevated to Honorary Membership shall retain all of the rights and privileges of corporate membership. (The new proposed paragraph 2 makes it necessary to change the numbering of the present paragraphs 2 and 3 to 3 and 4.)

(2) Art. B4, Par. 2 (New). Promotion to Fellow shall be made *only on the nomination* to the Council on an approved form by five (5) Fellows or Members.

Par. 3 (Present Par. 2). Fifteen (15) affirmative votes of the Council shall be required for the election of a candidate *or nominee* for any grade except Honorary Membership. Two (2) negative votes shall defeat an election.

Par. 4 (change in numbering from 3 to 4).

Par. 5 (Present Par. 4). All matters relating to admissions and to promotions in membership shall be in charge of the *Admissions Committee under the direction of the Board on Membership.*

Par. 6 and 7 (Changes in numbering from 5 and 6 to 6 and 7).

Par. 8 (Changes number from 7 to 8 and substitutes words "Medals Committee" for "Committee on Medals."

(3) Art. B6A, Par. 19. The Amendment proposes a substitution of the words "Canons of Ethics for Engineers" for the words "Code of Ethics" whereever they appear in the paragraph.

(4) Art. B15, Par. 1. All members of the Society shall subscribe to the *Canons of Ethics for Engineers* formulated by the Engineers Council for Professional Development and ratified by the Council on October 10, 1947, together with such amendments as may be approved by ECPD from time to time, provided such amendments are ratified by the Council.

Canons of Ethics for Engineers incorporated in this paragraph were published on pages 379 and 380 of the April, 1948, issue of MECHANICAL ENGINEERING.

(5) Art. B6A, Par. 2 (First reading). *The Council may delegate to the Boards established in the By-Laws,* for a period of one year, its authority for specific responsibilities for the performance of any duties required to be performed by the Council subject to any limitations prescribed by the Council. One member of each Board shall be a Director at Large appointed annually. The Chairman of each Board shall be entitled to a seat in the Council, without vote.

Par. 12 (First reading). This amendment substitutes the words "Constitution and By-Laws Committee" for "Committee on Constitution and By-Laws."

Par. 15 (First reading). The Board on Technology, under the direction of the Council, shall have supervision of the meetings of the Society (except business meetings), publications, divisions, and the research activities. *The Board shall consist of nine (9) members; one (1) Director at Large, four (4) members at large, and a member (preferably the chairman) of the Meetings, Professional Divisions, Publications, and Research Committees. The four (4) members at large shall each serve for four (4) years and the term of one (1) member shall expire at the close of each Annual Meeting.*

(6) Art. B9, Par. 1 (First reading). A Semi-Annual Meeting shall be held upon the recommendation of the *Board on Technology* and authorization by the Council at its regular meeting at the previous Semi-Annual Meeting.

Par. 2 A General Meeting shall be held upon the recommendation of the *Board on Technology* and authorization by the Council.

Par. 5 All Meetings of the Society, except business meetings, shall be in charge of the Meetings Committee, under the direction of the *Board on Technology.*

(7) Art. B13, Par. 1 (First reading). All publications of the Society shall be in charge of the *Publications Committee,* under the direction of the *Board on Technology.*

(8) Art. B16, Par. 3 (First reading). This amendment deletes the present paragraph 3 and changes the numbering of the present paragraphs 5 and 6 to paragraphs 4 and 5.

Amendments to Rules

(1) Art. R3, Rule 2. The amendment removed periods in the abreviation A.S.M.E. where it appears in the paragraph.

(2) Art. R10, Rule 1. When a number of members of the Society interested in a particular branch of the work of the Society favor the formation of a Professional Division for that branch, they may draw up a petition for the establishment of such a Division. Each such petition shall be sent to the *Professional Divisions Committee* for presentation to the Council with its recommendation. Upon

ASME MEMBERS TELEVISED OVER STATION WTMJ-TV, MILWAUKEE, WIS, DURING THE 1948 SEMI-ANNUAL MEETING

(*Left to right:* Ernest Hartford, Mrs. Sheehan, W. M. Sheehan, Mrs. L. H. Stark, and announcer, Art Whitfield.)

approval of the petition by the Council, the chairman of the *Professional Divisions Committee* shall appoint a temporary Chairman of the New Division.

Rule 3. Upon the organization of a Professional Division the initial selection of the executive committee shall be made by the *Council* upon the nomination of the *Professional Divisions Committee* which will state the length of term of each appointee.

Rule 4. During the month of October of each year the executive committee of each Division will nominate to the *Council* through the *Professional Divisions Committee* one or more individuals from whom the *Council* shall appoint the new member of the executive committee.

Rules 9 and 11. These amendments substitute "Professional Divisions Committee" for "Standing Committee on Professional Divisions."

(3) Art. R14, Rules 2 and 3. These rules are deleted and the present Rule 4 is changed to Rule 2.

(4) Art. R15, Rule 1. The Words "Canons of Ethics for Engineers" are substituted for the words "Code of Ethics."

Rule 2. The word "canons" is substituted for "code."

(5) Art. 15, Rule 2(h). The words "subject to the approval of counsel of the Society" are deleted from the present rule.

Report of 1948 Semi-Annual Business Meeting

THE members of the Society in a business session at the Semi-Annual Meeting at Milwaukee on June 1, 1948, elected the 1949 Nominating Committee, voted to submit to member ballot four amendments to the Constitution, and heard a discussion of Society operation by H. H. Snelling of Washington, D. C.

The names for the 1949 Nominating Committee selected by the eight Regional Administrative Committees and confirmed by the Regional Delegates Conference which met at Milwaukee were presented to the Business Meeting by Edward H. Walton of New Haven, Conn., and unanimously elected. (Nominating Committee is listed elsewhere on this page.)

The amendments to the Constitution which were referred to the members by letter ballot included:

A clarification of the language prescribing the selection of the Vice-President to fill a vacancy in the office of president;

A provision by which the Regional Delegates Conference might be held at any time during the year rather than only at the Annual Meeting as is now specified;

A provision to include the Canons of Ethics for Engineers as proposed by Engineers' Council for Professional Development; and

A provision that a member of the Society who has been honored by selection as an Honorary Member, shall retain his corporate status.

Following these matters of business, H. H. Snelling of Washington, D. C., discussed Society operation. He questioned the extent to which Council was delegating functions to the Executive Committee; he urged the extension of authority to the Regional Vice-Presidents; he questioned the extent to which Council was delegating its work to the several Boards and he opposed any possible change from the present method by which the members express their opinions by letter-ballot to a procedure of proxy voting by which their views are canvassed only at Business Meetings.

Mr. Snelling's remarks by motion were referred to the Constitution and By-Laws Committee for study.

The meeting thereupon adjourned.

ASME 1949 Nominating Committee Organizes

SELECTED at the 1948 Semi-Annual Business Meeting of The American Society of Mechanical Engineers, Milwaukee, Wis., June 1, 1948, the 1949 Nominating Committee at its organization meeting chose (temporarily, or until next Annual Meeting) Wm. H. Oldacre, D. A. Stuart Oil Company, 2727 S. Troy St., Chicago 23, Ill., as chairman and secretary.

Plans were made for a preliminary meeting of the committee at the 1948 Annual Meeting, New York, N. Y., at which arrangements will be made as to time and location of the executive meeting for nominations of the Society Officers in 1949.

The 1949 National Nominating Committee is composed of the following:

REGION I: T. A. Fearnside, Stone and Webster Engineering Company, 49 Federal St., Boston 7, Mass.; E. W. Harrington, *1st Alternate*, Manufacturers Mutual Fire Insurance Company, 1550 Turk Head Bldg., Providence, R. I.; R. G. Chapman, *2nd Alternate*, University of Vermont, Burlington, Vt.; and L. A. Lachman, *3rd Alternate*, Farrel-Birmingham Company, Inc., Water St., Stonington, Conn.

REGION II: H. C. R. Carlson, 209 Clinton Ave., Brooklyn 5, N. Y.; H. R. Kessler, *1st Alternate*, Republic Flow Meters Company, 420 Lexington Ave., New York, N. Y.; V. W. Smith, *2nd Alternate*, Lummus Company, 420 Lexington Ave., New York, N. Y.

REGION III: P. C. Osterman, American Gas Furnace Company, Spring and Lafayette Streets, Elizabeth, N. J.; Henry H. Snelling, *1st Alternate*, Snelling and Hendricks, 900 F St., N. W., Washington 4, D. C.; Wm. G. McLean, *2nd Alternate*, Lafayette College, Easton, Pa.

REGION IV: S. B. Earle, school of engineering, Clemson College, Clemson, S. C.; Claude L. Huey, *1st Alternate*, Babcock and Wilcox Company, 1203 Candler Building, Atlanta, Ga.; Louis G. Haller, *2nd Alternate*, Tennessee Eastman Corporation, Kingsport, Tenn.

REGION V: Tomlinson Fort, central stations department, Westinghouse Electric Corporation, East Pittsburgh, Pa.; J. W. Brennan, *1st Alternate*, American Blower Corporation, 8111 Tireman Ave., Detoit 32, Mich.; F. F. Borries, *2nd Alternate*, 5685 Belmont Ave., Cincinnati 24, Ohio.

REGION VI: Wm. H. Oldacre, D. A. Stuart Oil Company, 2727 S. Troy St., Chicago 23, Ill.; G. R. McNeile, *1st Alternate*, 806 E. Miner St., South Bend 17, Ind.; H. L. Heywood, *2nd Alternate*, Kearney and Trecker Corporation, 6784 W. National Ave., West Allis, Wis.

REGION VII: Bertram G. Dick, Dept. of Interior, Bonneville Power Administration, 1300 N. E. Union Ave., Portland, Ore.; Fairman B. Lee, *1st Alternate*, Lee and Freeman, Inc., 1550 1st Ave. S., Seattle 4, Wash.; Herbert I. Chatterton, *2nd Alternate*, Everett Pacific Shipbuilding and Drydock Company, Everett, Wash.

REGION VIII: A. A. Woodward, Public Service Company of Colorado, 900—15th St., Denver 2, Colo.; Henry B. Atherton, *1st Alternate*, Kansas City Power and Light Company, Kansas City 1, Mo.; Venton L. Doughtie, *2nd Alternate*, University of Texas, University Station, Austin 12, Texas.

Universities Honor Engineers

DURING the recent June season of university commencement excercises, four members of the ASME have been awarded honorary degrees for their achievements in the engineering field.

Lewis K. Sillcox, Fellow ASME, of Watertown, N. Y., was honored by Syracuse University when Chancellor William P. Tolley conferred upon him the honorary degree of doctor of laws, citing his technical articles on engineering subjects, which articles have been employed in teaching students at such engineering schools as Syracuse, the Massachusetts Institute of Technology, and Harvard University. Mr. Sillcox is first vice-president of the New York Air Brake Company.

Max Jakob, Mem. ASME, research professor of mechanical engineering at Illinois Institute of Technology, was made an honorary doctor of engineering by Purdue University.

George R. Rich, hydraulics engineer with Charles T. Main, Inc., of Boston, Mass., is the third ASME member honored. Mr. Rich received an honorary doctorate in engineering from the Worcester Polytechnic Institute, Worcester, Mass.

Clarence E. Davies, secretary ASME, received the honorary degree of doctor of engineering from Clarkson College of Technology, Potsdam, N. Y., at the commencement exercises on Sunday, June 20, 1948.

Chicago Engineers to Honor Wilfred Sykes

WILFRED SYKES, Mem. ASME, president of Inland Steel Company, Chicago, Ill., will receive the 1948 Award of Merit by the Chicago Technical Societies Council it was announced recently.

Wright Field Flight-Test Demonstrations to Be Feature of ASME Aviation Conference

Dayton, Ohio, Sept. 20 and 21

MEMBERS and guests of the Aviation Division of The American Society of Mechanical Engineers who attend the ASME 1948 Aviation Conference, to be held at the Engineers' Club of Dayton, Ohio, Sept. 20 and 21, 1948, will have a rare opportunity to inspect the facilities and the latest American fighting aircraft stationed at the Wright-Patterson Air Force Base, Wright Field, Dayton, Ohio. The opportunity is limited, however, to American citizens who meet the requirements of the Security Division at Wright Field.

Security Questionnaire

To facilitate security clearance, the ASME Aviation Division has prepared a questionnaire soon to be in the mails, which must be filled out and returned to Burson Treadwell, 1216 Oakdale Avenue, Dayton 10, Ohio, not later than Aug. 15, 1948, by members and guests who wish to participate in the inspection tour. Those not cleared for admittance to the Field will be notified promptly by Mr. Treadwell. Additional copies of the questionnaire may be obtained from headquarters.

The conference will consist of two technical sessions at which four technical papers will be presented. During the second session, the Engineers' Club of Dayton will contribute a surprise feature which should be of interest to all engineers working in the aviation industry. In addition to the technical sessions, a luncheon and a banquet will complete the program of the first day. Technical sessions will be held at the Engineers' Club of Dayton, while luncheon and dinner will be held at the Dayton-Biltmore Hotel.

Flight-Test Demonstrations

The entire second day will be given over to inspection tours of the Power Plant Laboratory and the Aircraft Equipment Laboratory at Wright Field, and to static display and flight-test demonstrations of the latest types of aircraft stationed at the Field. This part of the conference will be restricted to American citizens who are passed by the Security Division at Wright Field.

The program of the Conference follows:

Monday, Sept. 20

8:00 a.m.

Registration

Engineers' Club of Dayton

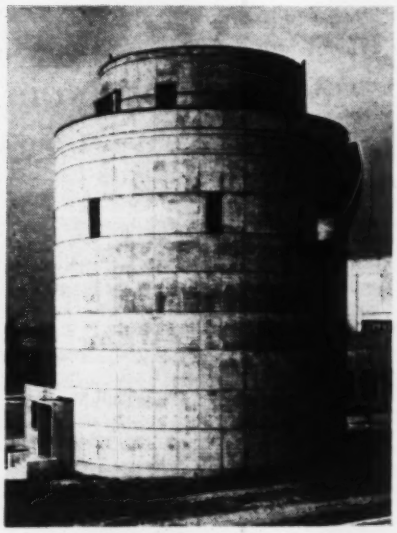
9:30 a.m.

First Session

Auditorium—Engineers' Club of Dayton

Analysis of the Activities of Navigators During Three Arctic Missions, by J. M. Christenson, research psychologist, psychology branch, Aeronautical Medical Laboratory, Wright-Patterson Air Force Base, Dayton, Ohio.

Cockpit-Design Problems of High-Altitude, High-Speed Flight, by J. E. Sullivan, director, Airborne Equipment Division, Bureau of Aeronautics, Navy Department, Washington, D. C.



VERTICAL WIND TUNNEL OF THE AIR MATERIEL COMMAND, WRIGHT FIELD, DAYTON, OHIO. THE STRUCTURE IS USED TO DETERMINE AIRPLANE SPIN CHARACTERISTICS, TERMINAL VELOCITY STUDIES AND PARACHUTE RESEARCH.

12:15 p.m.

Luncheon

Junior Ballroom, Dayton-Biltmore Hotel

2:00 p.m.

Second Session

Auditorium, Engineers' Club of Dayton

Turbojet Engine Controls, by C. S. Cody, section engineer, aviation gas turbine division, Westinghouse Electric Corporation, Philadelphia, Pa.

Thrust Augmentation as Applied to the Turbojet Engine, by Edward Woll, development engineer, aircraft gas turbine engineering division, General Electric Company, West Lynn, Mass.

7:00 p.m.

Banquet

Speaker: Gen. S. R. Brentenall, Wright-Patterson Air Force Base, Dayton, Ohio

Subject: The General Problem of Designing for Environment

Tuesday, Sept. 21

All-day tour of Wright Field restricted to American citizens cleared by the Security Division, Wright Field

9:00 a.m.

Buses leave Dayton-Biltmore Hotel

10:00 a.m.

Static display of latest aircraft

11:00 a.m.

Flight-test demonstration of all types of aircraft

11:45 a.m.

Luncheon

1:30 p.m.

Tour of power plant laboratory

Tour of aircraft equipment laboratory

4:00 p.m.

Buses leave for Hotel

Committees

The following committees are in charge of the conference:

ASME Aviation Division Executive Committee, F. K. Teichmann, chairman; ASME Dayton Section, Executive Committee, F. H. McCormick, chairman; Arrangements, E. D. Smith, chairman; Technical Events, R. G. Olt, chairman; Finance, A. W. Kimmel, chairman; Banquet and Luncheon, Collins Wright, chairman; Wright Field Trip, Lieut. Col. E. N. Ljundgren, chairman; Reception, Registration and Information, B. F. Downey, chairman; Publicity, W. A. Chryst, chairman; and Women's Entertainment, Mrs. F. H. McCormick, chairman.

500 Attend Heat Transfer and Fluid Mechanics Institute

THE first Heat Transfer and Fluid Mechanics Institute was held in Los Angeles, Calif., June 21–23, 1948, on the campuses of the University of California at Los Angeles, University of Southern California, and the California Institute of Technology. Sponsored by the California Sections of scientific and engineering societies, including the ASME, western universities, Jet Propulsion Laboratory of the California Institute of Technology, and the Project SQUID (a co-operative research project of five eastern and five western universities), the Institute consisted of 12 technical sessions conducted on a highly scientific level at which basic problems of heat transmission and fluid flow were discussed. Average attendance at the sessions was 462 and 28 per cent of those who registered came from states other than California.

L. A. Appley Appointed AMA President

APPOINTMENT of Lawrence A. Appley Assoc. ASME, vice-president of Montgomery Ward and Company, as president of the American Management Association, and elevation of Alvin E. Dodd, Fellow ASME, to AMA president for the past 12 years, to the newly created post of honorary president was announced recently.

New ASME Petroleum Division Organized

PROFESSIONAL-DIVISION status was conferred recently by the Council of The American Society of Mechanical Engineers on the Petroleum Committee of the Process Industries Division in recognition of the Committee's success in reorganizing ASME activities in the field of petroleum mechanical engineering. The ASME now has 20 active divisions and one which is currently inactive.

Organized by a group of 13 men under the leadership of William Raisch Mem. ASME, in June, 1944, the Committee set to work reactivating ASME interests associated with ASME mechanical problems of the petroleum industry. Two years later the Committee entered the "big league" among ASME program-making agencies, by sponsoring a full-fledged National Conference on Petroleum Mechanical Engineering at which a program of 37 technical papers attracted an attendance of 400. Greater attendance at the 1947 conference and the enthusiasm evident for the 1948 conference indicates that the Committee has succeeded in providing a service and leadership appreciated by the petroleum industry. More than 900 engineers have indicated an interest in the Committee's work.

At its first meeting, the Committee charted its interests as the mechanical problems of production, refining, transportation, materials, manufacture of petroleum equipment, and application. Programs in two other fields of the petroleum industry are under consideration: education and junior-engineer activities.

The objectives of the new Division are:

(1) To promote and exchange information pertaining to the mechanical problems involved in the production, transportation, refining, and the use of petroleum and its products.

(2) To co-operate with other divisions and committees of the Society on interrelated problems.

(3) To co-operate and collaborate with other associations and societies.

(4) To disseminate information pertaining to petroleum (in so far as such information falls within the scope of this Committee's activities) through the presentation, discussion, and publication of technical matter related to the industry.

(5) To provide a common meeting ground where all members of the Society interested in petroleum and its products may gather and exchange experiences and technical data beneficial to the members and the petroleum industry as a whole.

The 1948 project of the Division is the third annual conference to be held at the Herring Hotel, in Amarillo, Texas, Oct. 3 to 6, 1948. Twelve technical sessions are planned, covering mechanical aspects in all fields of the petroleum industry.

Members interested in the work of the Petroleum Division are urged to write to Headquarters.

ASME Calendar

of Coming Events

Sept. 7–9, 1948
ASME Fall Meeting, Reed College, Portland, Ore.

Sept. 13–17, 1948
ASME Instruments and Regulators Division Meeting, Convention Hall, Philadelphia, Pa.

Sept. 20–21, 1948
ASME Aviation Division Meeting, Engineers Club of Dayton, Dayton, Ohio.

Oct. 3–6, 1948
ASME Petroleum Division Conference, Herring Hotel, Amarillo, Texas.

Oct. 14–15, 1948
ASME Wood Industries Division Conference, Sheraton Hotel, High Point, N. C.

Nov. 3–4, 1948
ASME Fuels Division—AIME Coal Division Meeting, Greenbrier Hotel, White Sulphur Springs, W. Va.

Nov. 28–Dec. 3, 1948
ASME Annual Meeting, Hotels Pennsylvania and New Yorker, New York, N. Y.

Jan. 10–14, 1949
ASME Materials Handling Division and Management Division Meeting, Convention Hall, Philadelphia, Pa.

April 25–27, 1949
ASME Spring Meeting, Hotel Mohican, New London, Conn.

ASME Oil and Gas Power Division Commemorates 50th Anniversary of Diesel Engine in America

UNDER the sponsorship of the Oil and Gas Power Division and the St. Louis Section of The American Society of Mechanical Engineers, the 20th Oil and Gas Power National Conference was effectively utilized to mark the 50th anniversary of the Diesel engine in America. The event, held in the New Jefferson Hotel, St. Louis, Mo., May 20–22, 1948, was the subject of an attractive booklet describing the origin and history of the ASME Oil and Gas Power Division, listing the papers presented at the various technical sessions, and displaying the products designed for Diesel and gas-engine use by 45 manufacturers, who exhibited at the conference. Copies of the booklet are available and may be obtained by writing to Headquarters.

The St. Louis Section was most hospitable in their welcome of members, guests, and exhibitors. Actively heading up the St. Louis Section Committees were G. V. Williamson, chairman; F. V. Hartman, secretary-treasurer; Charles S. Fox, C. E. Beck, and David Larkin with other members giving excellent support and co-operation in the many and varied details incident to every meeting of this kind. An active Womens' Committee arranged interesting tours and luncheons.

At the informal banquet held May 21, Prof. Glenn C. Boyer, chairman for 1948, presided, and the speaker, Joseph F. Holland, St. Louis attorney and banker, gave an interesting and inspirational talk illustrating how a civic-minded city government can accomplish results on such activities as smoke abatement and slum clearance, if businessmen, engineers, and other professions co-operate in making such ventures the joint efforts of all citizens.

Five technical sessions were held at which 11 papers were presented. Among them were a series of four papers devoted exclusively to the history of the oil engine in America, "A Half Century of Diesel Development in America." These and the other papers will be published in a special Oil and Gas Power Proceedings, which has been the practice for many years.

Lecture Course Popular

A preconference lecture course was held on May 19 on the subject of lubrication. Ninety engineers, designers, and research workers attended the three lectures composing this event. These lectures, designed to complement the very successful lecture series of last year on "Diesel Fuel Oils," will also appear as a separate Oil and Gas Power Division publication at an early date.

Plant-inspection trips were made to the Busch-Sulzer Bros. Division, Nordberg Manufacturing Company; Aluminum Ore Company to inspect the Nordberg radial Diesel engine recently perfected in conjunction with that company; Shell Oil Company Lubrication Laboratory; and the Carter Carburetor Company.

R. T. Sawyer, 1949 Chairman

The Oil and Gas Power Division officers for 1949 consist of R. T. Sawyer, American Locomotive Company, chairman; W. W. Young, *Diesel Progress*, secretary; and G. C. Boyer, L. N. Rowley, T. M. Robie, and Robert Cramer, Jr., as the other members of the Executive Committee. New associates elected were Stuart Nixon, K. W. Stinson, Edwin Crankshaw, and C. F. Foell, who is the retiring secretary.

At the Executive Committee meeting held on Saturday, May 22, plans were made to hold the next conference in Chicago, Ill., at Hotel Sherman during the week of April 24, 1949.

Third Instrument Conference to Be Held in Philadelphia, Pa., Sept. 13–17

THE Industrial Instruments and Regulators Division of The American Society of Mechanical Engineers is co-operating with three other organizations working in the instruments field in sponsoring the Third Instrument Conference to be held in Convention Hall, Philadelphia, Pa., Sept. 13–17, 1948. Other co-operating societies are: Instruments Society of America, The American Institute of Physics, and America Institute of Electrical Engineers.

As part of the conference, the Instruments Society of America is sponsoring an exhibit of the products of many of the manufacturers of industrial instruments and regulators.

The four-day program consists of 15 technical sessions at which 36 papers will be presented on such subjects as ordnance instruments, temperature and pressure elements, automatic controls, control valves, process control instrumentation, and scientific and electronic instruments.

The first ASME session on Monday afternoon, Sept. 13, will discuss temperature and pressure elements. On Tuesday, Sept. 14, Pres. E. G. Bailey will address an ASME-sponsored luncheon on "Engineers' Opportunities in the Field of Instruments and Controls." A session of process-control instrumentation sponsored by the ASME will follow the luncheon.

The Tentative Program

MONDAY, SEPT. 13

10:00 a.m.

(ISA) Ordnance Instruments

Room 200

Recent Developments in Servomechanisms, by Robert S. Edwards, Sperry Gyroscope Company, Great Neck, L. I.

The Instrumentation of the "Bat," by H. K. Shramstad, Ordnance Development Laboratory, Washington, D. C.

Temperature and Pressure Measurements in Rockets, by R. J. Havens, Naval Research Laboratory, Washington, D. C.

2:30 p.m.

(ASME) Temperature and Pressure Elements

Room 200

Response Characteristics of Resistance Thermometers, by A. J. Hornfeck, Bailey Meter Company, Cleveland, Ohio

Bourdon Tubes in 5000-Psi Pressure Transmitters, by O. C. Brewster, consultant, Litchfield, Conn.

8:00 p.m.

(ISA) Automatic Control

Ballroom

Demonstration of Automatic Control Principles, by Gerald F. Akins, assisted by John H. Kowalski, Eastman Kodak Company, Rochester, N. Y.

TUESDAY, SEPT. 14

10:00 a.m.

(ISA) Control Valves

Room 200

Valve Characteristics and Automatic Control, by J. G. Ziegler and N. B. Nichols, Taylor Instrument Companies, Rochester, N. Y.

Control Valve Body Design, by D. P. Eckman, Cornell University, Ithaca, N. Y., and R. B. Werey, Conoflow Corporation, Philadelphia, Pa.

The Liquid-Flow Characteristics of a Pipe Line and a Control Valve, by Otto Kneisel, Hammel-Dahl Company, Providence, R. I.

10:00 a.m.

(AIP) Scientific Instruments

Room 300

Electron Microscopy, by James Hillier, Radio Corporation of America, Princeton, N. J.

The Measurement of the Particle Size of Sub-Sieve Powders, by R. E. Payne, Sharples Corporation, Philadelphia, Pa.

Infrared Instrumentation, by Van Zandt Williams, American Cyanamid Company, Stamford, Conn.

12:30 p.m.

(ASME) Luncheon

Convention Hall

Speaker: E. G. Bailey, president ASME

Subject: Engineers' Opportunities in the Field of Instruments and Control

2:30 p.m.

(ASME) Process Control

Room 200

The Control Valve in Operation, by W. H. Kidd and G. A. Philbrick

Functional Flexibility in Process Control, by F. H. Trapnell, E. I. du Pont de Nemours and Company, Wilmington, Del. (tentative)

8:00 p.m.

(ISA) Electronics

Looking Into the Future of Electronics, by Gordon Volkenant, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn.

WEDNESDAY, SEPT. 15

10:00 a.m.

(ISA) Cascade Controls

Room 200

The Use of Interconnected Control Instrumentation for Offsetting Unfavorable System Characteristics, by J. A. Pellettere, Gulf Oil Corporation, Pittsburgh, Pa.

Instrumentation—By and With Controlled-Volume Pumps, by Robert T. Sheen, Milton Roy Company, Philadelphia, Pa.

The ABC's of Multi-Element Control, by C. H. Barnard, Bailey Meter Company, Cleveland, Ohio

10:00 a.m.

(AIP) Scientific Instruments

Room 300

The Physical Principles of Vacuum Measurements and Production, by C. H. Bachman, Syracuse University, Syracuse, N. Y.

Acoustics Instrumentation, by Richard H. Bolt, Massachusetts Institute of Technology, Cambridge, Mass. and Richard K. Cook, National Bureau of Standards, Washington, D. C.

The Tools of the Physics Teacher, by Richard M. Sutton, Haverford College, Haverford, Pa.

6:30 p.m.

Banquet

THURSDAY, SEPT. 16

10:00 a.m.

(ISA) Control Instrumentation

Room 200

Supervisory Control Systems, by Louis Gess and R. M. Hutchinson, Brown Instrument Company, Philadelphia, Pa.

Pneumatic Transmissions, by V. V. Tivy, Foxboro Company, Foxboro, Mass.

10:00 a.m.

(AIP) Scientific Instruments

Room 300

Radio Spectroscopy, by Charles H. Townes, Columbia University, New York, N. Y.

Gas Analysis by the Mass Spectrometer, by Alfred O. C. Nier, University of Minnesota, Minneapolis, Minn.

Radioactive Tracer Techniques and Measurements, by L. F. Curtiss, National Bureau of Standards, Washington, D. C.

2:30 p.m.

(AIEE) Electronic Instruments

Room 200

Fail-Safe Operation of Electronic Circuits, by G. D. Hanchett, Radio Corporation of America, Camden, N. J.

Cathode-Ray Oscillograph Developments for Laboratory and Production Use, by A. Barkley, Allen B. DuMont Laboratories, Inc.

Oil-Film Thickness Indicator for Journal Bearings, by M. L. Greenough, National Bureau of Standards, Washington, D. C.

8:00 p.m.

(ISA) Instruments in Crime Detection

Science in Crime Detection, by L. V. Boardman, Federal Bureau of Investigation, Philadelphia, Pa.

FRIDAY, SEPT. 17

10:00 a.m.

(ISA) General Instrument Session

Room 200

Deviations from the Square-Root Law in the Measurement of Small Flows, by Henry W. Stoll, Taylor Instrument Company, Rochester, N. Y.

Instrument Engineering Department—A Luxury or a Necessity?, by J. Johnston, Jr.,

E. I. du Pont de Nemours Corporation, Wilmington, Del.

The Development of Instrument Curricula, by M. B. Hall, Foxboro Company, Foxboro, Mass.

2:30 p.m.
(AIEE) Electronic Instruments

Room 200

A Study of Slide Wire Contact Resistances, by W. E. Belcher, Jr., Brown Instrument Company, Philadelphia, Pa.

Development of Self-Balancing Recorders, by A. J. Williams, Jr., Leeds and Northrup Company, Philadelphia, Pa.

Salinity-Temperature-Depth Recorder, by A. W. Jacobson, Bristol Company, Waterbury, Conn.

A. G. Christie Awarded ASEE Lamme Medal

ALEXANDER G. CHRISTIE, honorary member and past-president ASME, was presented the 1947 Lamme Medal of the American Society for Engineering Education at the annual dinner of that society held in Austin, Texas, June 16, 1948.

Dr. Christie, who is professor of mechanical engineering at Johns Hopkins University, Baltimore, Md., received the award for his accomplishments in technical teaching and the advancement of the art of technical teaching.

The Lamme Medal was established through a bequest of Benjamin Graver Lamme, who was chief engineer of the Westinghouse Electric Corporation from 1903 to his death in 1924. He provided also for a medal to be awarded by the American Institute of Electrical Engineers for pioneer work in electrical engineering, and for a medal to be awarded by The Ohio State University, from which he was graduated in 1888, to a graduate of that university for meritorious achievement in engineering.

C. J. Freund Elected ASEE President

Hunter Rouse Honored

C. J. FREUND, member ASME, dean of the College of Engineering at the University of Detroit, has been elected president of the American Society for Engineering Education for 1948–1949, it was announced at the recent annual convention of the Society at the University of Texas, Austin, Texas.

Long prominent in engineering and educational circles, especially as an advocate of cooperative engineering education, Dean Freund was a vice-president of the Society last year. He is also a member of the ASME Education Committee.

Upon the retirement of B. J. Robertson, member ASME, of the University of Minnesota at Minneapolis, Minn., Thorndike Saville, dean of New York University's College of Engineering, has been elected to fill the two-year vice-presidency.

F. M. Dawson, dean of the University of Iowa College of Engineering, has been reelected vice-president in charge of the Engineering College Research Council for another term.

C. J. FREUND, MEM. ASME, WHO WAS ELECTED 1948-1949 PRESIDENT OF THE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Other officers of the Society remain in their former positions. S. S. Steinberg of the University of Maryland is still a vice-president and chairman of the Engineering College Administrative Council. Arthur B. Bronwell of Northwestern University is secretary, and J. S. Thompson of the McGraw-Hill Book Company is treasurer.

To Hunter Rouse, member ASME, and director of the Iowa Institute of Hydraulic Research as well as professor of fluid mechanics at the State University of Iowa, went the $1000 George Westinghouse Award. Sponsored by the ASEE, the award is presented annually for "distinguished contributions to the teaching of engineering students."

Professor Rouse was cited specifically "for his extensive influence upon the teaching of fluid mechanics, for his revealing synthesis of diverse information, and for his inspiring guidance to students and associates.

ASME Honors Secretary George C. Marshall

SECRETARY of State George C. Marshall received a certificate of honorary membership in The American Society of Mechanical Engineers on July 9, 1948, in a brief ceremony during an informal luncheon in his honor at the Hotel Statler, Washington, D. C. E. G. Bailey, president ASME, conferred the honor.

Secretary Marshall was cited by the Society "for his distinguished services in military science and as Chief of Staff and General of the Army during World War II and as present Secretary of State." The honorary membership originally was scheduled to be conferred last December during the Annual Meeting, but was deferred because of Secretary Marshall's attendance at the Council of Foreign Ministers in London at that time.

Some 20 officers of the ASME and guests attended the luncheon. Those present besides Secretary Marshall and Mr. Bailey included: Ralph E. Flanders, Republican Senator from Vermont; D. Robert Yarnall and Eugene W. O'Brien, past-presidents of ASME; Paul G. Hoffman, Economic Co-Operation Administrator; W. A. Wrathers, president, AIME; C. E. Davies, secretary, ASME; Stewart E. Reimel, mem. ASME; and Paul B. Eaton, vice-president ASME Region III.

Also present were: Rear admiral T. A. Solberg, Rear Admiral Harold G. Bowen, Brig. Gen. Marshall Carter, Brig. Gen. John K. Christmas, Brig. Gen. Richard C. Coupland, Ralph L. Goetzenberger, Abbott L. Penniman, Jr., William M. Sheehan, and Norman A. Shepard.

High Mark Set by 1947 Annual-Meeting Publicity

THAT the 1947 Annual Meeting of The American Society of Mechanical Engineers held at Atlantic City, N. J., was one of the best

SECRETARY OF STATE GEORGE C. MARSHALL RECEIVES CERTIFICATE OF HONORARY MEMBERSHIP IN ASME AT CEREMONY IN WASHINGTON, D. C.

(*Left to right:* Paul G. Hoffman, Eugene W. O'Brien, Secretary George C. Marshall, E. G. Bailey, President ASME, and Senator R. E. Flanders.)

publicized meetings of the Society, is borne out by the final tabulation of clippings from newspapers and periodicals reported by George A. Hastings, ASME director of public relations. The 1947 clippings number four times those for the 1946 meeting and the space devoted to ASME news exceeds by almost three times that received in the previous year.

Growing recognition by the press of the importance and prestige of the Society, more papers containing a larger content of matter of general interest, and important speakers appearing before the ASME, were given as the reasons for the public's interest in ASME activities.

The following tables illustrate the comparative publicity results for the 1946 and 1947 Annual Meetings:

CLIPPINGS	1947	1946
Editorials	23	3
News stories, New York	77	60
News stories, outside	478	71
Periodical stories	192	59
Total	770	193
COLUMN INCHES OF SPACE		
Editorials	188	28
News stories, New York	608	690
News stories, outside	2516	418
Periodical stories	5755	1967
Total	9179	3103
TOTAL COLUMNS	456	155

Section Activities

REPORTS of the following ASME Section Meetings were received at Headquarters during the month of July, 1948:

Birmingham, May 14. Speaker: Blake R. Van Leer. Subject: UNESCO. Attendance: 100.

Central Pennsylvania, May 4. Speaker: H. Toerner. Attendance: 200.

Columbus, President's Night Dinner. Attendance: 215.

Dayton, May 11. Speaker: Don F. Copell. Subject: The Engineer's Philosophy and Your Business. Attendance: 85.

Southern California, June 15. Speaker: Wm. V. Reed. Subject: Prefabricated Housing. Attendance: 70.

South Texas, June 11. Speaker: C. E. Davies. Subject: Report on International Management Congress. Attendance: 30.

Toledo, June 10. Cruise and dinner. Attendance: 80 members.

West Virginia, May 25. Speaker: T. Napier Adlam. Subject: Radiant Heating. Attendance: 125.

Fort Wayne, June 17. Inspection trip through United States Rubber Company's plant, Fort Wayne, Ind.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., which is under the joint management of the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to members and is operated on a co-operative nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrants whose notices are placed in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available to members of the co-operating societies at a subscription of $3.50 per quarter or $12 per annum, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th St.	84 East Randolph Street	109 Farnsworth Ave.	57 Post Street

MEN AVAILABLE[1]

CHIEF ENGINEER, 47, married; master's degree, M.I.T.; mechanical, electrical, hydraulic. Widely experienced engineer with exceptionally broad technical knowledge and high analytical capacity. Competent director of engineering, development, and research. Available upon two weeks' notice. Location preferred, California. Me-313-4610-D-12.

RESEARCH-DEVELOPMENT ENGINEER, 27, receiving MS mechanical engineering September, wants position developing special or new equipment, preferably involving combustion problems. Seven years' experience apparatus design, instrumentation, test, and analysis. Location preferred, West or Southwest. Me-314.

MECHANICAL ENGINEER, June 1948 graduate, 22 years old, married. Seeks position with future. Any location including outside U.S.A. Me-315.

GENERAL MANAGER, Columbia graduate, registered PE. Long experience with company manufacturing precision mechanical equipment; embracing organization, engineering, production, sales, advertising. Set up office-plant procedures. Developed cost system against pay-roll and material records. New York metropolitan area preferred. Will travel occasionally. Me-316.

YOUNG ENGINEER, three years' experience in sales, creative work, purchasing, personnel relations, and industrial engineering. Age 24. BSME and IE. Enthusiastic, determined, and understands human nature. Me-317.

ENGINEERING EXECUTIVE, 38, married. BS mechanical (industrial) engineering, W. Va., 1933. Professional license (W. Va.) Mem. ASME. Experience, six years plant construction, eight years mass production, two years sales. Me-318.

MECHANICAL ENGINEER, 27, married, BSME, desires foreign-staff position. Experienced in plant and industrial engineering. Available on two weeks' notice. Me-319-464-D-7.

MECHANICAL ENGINEER, ten years' practical engineering experience in research and development of vacuum pumps and microwave radio tubes. Desires responsible position as development or production engineer. Prefers New York, N. Y., location. Me-320.

POSITIONS AVAILABLE

MECHANICAL DRAFTSMAN to lay out and detail plumbing, heating, and ventilating equipment. $3900–$4420. New York, N. Y. Y-1045.

MECHANICAL ENGINEER with experience in shop work and also in general mechanical designing. Must be able to supervise shop mechanics. South. Y-1048.

INSTRUCTORS, bachelor of science degrees in mechanical or industrial engineering, or two-year technical-institute education and at least ten years' industrial experience. Three or more years' industrial experience desirable, but not necessary. (*a*) One for mechanical-engineering department, to teach engineering drawing, applied mechanics, materials of engineering, and machine design. (*b*) One for tool-engineering staff, to teach process engineering, manufacturing, and tool costs, tool design, etc. Positions start September 1, 1948. $3000 and up depending on qualifications. Connecticut. Y-1067.

MECHANICAL ENGINEER, thoroughly experienced in piping and some experience in ventilation work helpful. Should have at least fifteen years' experience for company constructing a large hospital and several related medical buildings in Venezuela. Y-1070.

MECHANICAL TEST ENGINEER, young, with at least two or three years' experience, preferably in power-plant test field and should have majored in technical writing or at least qualify in that line. Work will include checking technical articles on steam power-plant engineering; make charts, interpret drawings and charts, and, in general, revise and edit articles for technical publications. New York, N. Y. Y-1073.

MECHANICAL ENGINEER, 35–40, graduate, with die design and production experience on metal stampings, to be responsible for design and production of novelties and metal products. $7000–$7500. Northern New Jersey. Y-1077.

MECHANICAL DESIGNER-DRAFTSMAN, full responsibility on heating systems in industrial and commercial buildings, including the boiler plant and underground steam distributing system. South Carolina. Y-1095(c).

SALES ENGINEER, young, mechanical gradu-

(*ASME News continued page on 722*)

[1] All men listed hold some form of ASME membership.

A COMPLETE SYSTEM...

FOR INSTANT, ACCURATE CHECK ON LIQUID OR BOILER WATER LEVELS THROUGHOUT THE PLANT

Yarway Remote Liquid Level Indicator with Control Unit attached.

Now you can have constant check-up on water levels wherever —and whenever—you want.

The Yarway Liquid Level Indicator, equipped with Yarway Control Unit and auxiliary electric signalling devices, provides this check at two or more locations anywhere in the plant.

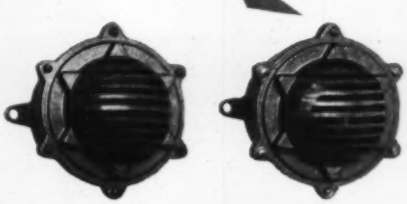
The Yarway Indicator is always accurate because it is operated by the liquid itself. Indicating mechanism is never under pressure. There are no stuffing boxes. Complete separation of indicating and actuating parts is achieved by permanent magnet transmission.

The Automatic Control Unit is attached directly to the Indicator and operates the remote signal alarms (light or horn) at any remote locations.

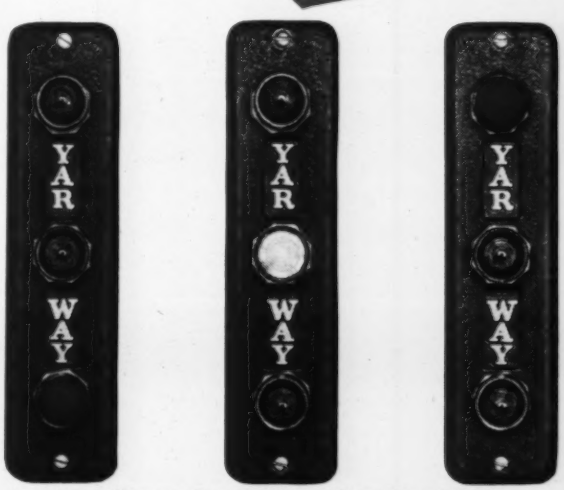
The Control Unit may also be used as a control for mechanical equipment such as motor-operated valves, pumps, etc.

FOR COMPLETE DESCRIPTION AND SPECIFICATIONS OF YARWAY REMOTE LIQUID LEVEL INDICATORS, WRITE FOR BULLETIN WG-1822.

YARNALL-WARING COMPANY
108 Mermaid Ave., Philadelphia 18, Pa.



Yarway Remote Hi-Lo-Alarm Signal Horns.



Three Yarway Remote Hi-Lo-Alarm Signal Lights, showing low level, normal operation and high level. Each unit shows all levels.

YARWAY REMOTE LIQUID LEVEL INDICATOR

ate, with equipment experience, to make layouts, prepare specifications and quotations, learn district-office sales and service routine and later become territorial sales representative for paint-spray manufacturer. $2700–$3300. East. Y-1096.

AERONAUTICAL ENGINEER with master's degree, to head aeronautical option in Midwestern college. Should preferably have teaching and industrial experience. Salary open. Y-1098-R-5022-D-4225.

ENGINEERS. (*a*) Mechanical engineer, 35–40, graduate, with plant engineering experience, to supervise manufacturing maintenance, improvement programs, and power plant. $5000. (*b*) Assistant mechanical engineer, 30–35, with plant engineering experience, to do drafting, planning, layout, and make tests. $4000. Connecticut. Y-1110.

ASSOCIATE PROFESSOR to teach machine design. Must have at least a bachelor's degree and should have had several years' experience in design and development, together with a liking for teaching. $4400–$5000 for nine months, depending on experience. South. Y-1113.

MANUFACTURING ENGINEER, BS degree preferred, with wood-utilization major preferred; industrial or mechanical engineering acceptable, and three to five years' experience for the following work: supervision of process planning and scheduling, time study, plant-facility layout for cabinet manufacture, establishment of manufacturing time standards, and the development of new and improved methods of manufacture. $4784. Virginia. Y-1117.

PRODUCTION ENGINEER, 35–55, with broad machine-shop experience in engine field, to supervise production of small gasoline engines. $6000–$8000. Northern New Jersey. Y-1122.

JUNIOR ENGINEER, recent mechanical graduate, interested in thermodynamics, fluid flow, and automatic control, to do design development and application engineering. $3000. Orange County, N. Y. Y-1123.

ENGINEERS. (*a*) Methods engineer with heavy and continuous experience in the aircraft or allied industries to be responsible for processing, tooling, equipment, the setup and continuing operations of all shop operations and mechanical productive work. (*b*) Superintendent, experienced in precision machine-shop work principally in the manufacture of experimental parts. Must have supervisory, administrative, and engineering-liaison experience in that connection. Work is of high-precision small-quantity character. (*c*) Superintendent, machine shop; responsible for general supervision of operations in machine shop. Must have broad, heavy, and progressive experience with machine-shop operation and supervision in the aircraft or allied industries. Salaries open. Eastern New York. Y-1126.

JUNIOR ENGINEER, mechanical, BSME, with consideration given for any postgraduate work. Prefer up to two years of industrial, manufacturing employment with a general mechanical background. Will assist senior engineers in carrying through major projects in general engineering. Projects involve problems in materials handling, fluid flow, electricity, steam and power generation, strength of materials, pressure-vessel design, and piping. Excellent opportunity for advancement. Several field trips each year to various plants to learn processes. $2600 and up, depending upon experience and qualifications. New York, N. Y. Y-1134.

INSTRUCTOR, young, BS in mechanical engineering. Prefer a man with at least one year of experience, but will consider a recent graduate. Will teach engineering drawing, elementary and advanced, and descriptive geometry. Salary dependent upon qualifications. Massachusetts. Y-1139.

DEVELOPMENT ENGINEER, mechanical graduate, with at least five years' design and operation experience covering pumps and turbines, to supervise experimental project. $5000–$6000. Western New York. Y-1152.

MECHANICAL ENGINEER, 30–40, with some practical operating experience in either an industrial or utility plant. Will be required to obtain data, study, analyze, and recommend solution to mechanical-power problems; engineer the design, layout, and purchase of equipment; place new equipment in service and instruct on operation; study, analyze, and recommend on proper operation of mechanical-power apparatus; supervise training of operating personnel; generally supervise operation. Salary open. Ohio. Y-1153-D.

MECHANICAL ENGINEER to teach thermodynamics and other mechanical-engineering subjects. Opportunity for advancement. Salary to start $3600–$4500 depending on experience. Assistance given in locating living accommodations. Ohio. Y-1159-D.

MACHINE DESIGNERS to work on fast-acting cams and followers and layout of same. Research program entirely. $4200–$4680. Connecticut. Y-1161.

ENGINEERS. (*a*) Director of engineering, to take over regular engineering design and be in charge of research and development on conveying machinery. About $10,000. (*b*) Machine designer, 25–35, to work on special machinery for breaking ice. About $5200 a year. Upstate New York. Y-1162.

EDITORIAL ASSISTANT, young, graduate mechanical engineer, who has had some writing experience, either on a college paper or other periodical. Experience on internal-combustion engines, particularly on Diesel engines, is very desirable. $3900 to start. New York, N. Y. Y-1163.

MECHANICAL ENGINEER, graduate preferred, with considerable experience in design of heating and ventilating systems, and capable of handling responsibilities. Must be able to make neat drawings. Rental of housing has been provided for. $5200–$6000. North Carolina. Y-1173.

PROCESS OR MANUFACTURING ENGINEER for medium-sized fabricating and assembly plant, particularly dealing with stamping, die casting, and plastic molding. Must be good administrator. Salary, $10,000 a year. Location, Connecticut. Y-1182.

CHIEF ENGINEER, mechanical, 35–50, with considerable experience in pressed-steel products. Must have complete knowledge of presses, power brakes, plant layout, and design of production. Prepare all schedules for shop. Salary open. New York metropolitan area. Y-1183.

ASSISTANT OR ASSOCIATE PROFESSOR for engineering college in Iowa. Assistant professor should have either excellent experience, background, or advanced degree in industrial engineering, mechanical engineering, or business administration. Teaching will be on industrial engineering. Associate professor would require an MS and should have had teaching experience. Salary for assistant professor, $3600–$4200 on nine-month basis with additional compensation for summer teaching; associate professor, $4000–$4800. R-4809.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Aug. 26, 1948, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

Re = Re-election; Rt = Reinstatement; Rt. & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Member, Associate, or Junior

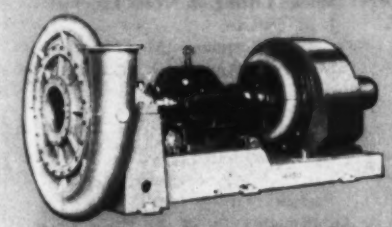
AMES, FREDERICK HARVE, JR., Richland, Wash.
ANDREWS, NORMAN W., JR., Baldwin, L. I., N. Y.
BAKER, JOHN HAYNES, Schenectady, N. Y.
BARNETT, SAMUEL CLARENCE, Atlanta, Ga.
BAYER, BRUCE M., Nashville, Tenn.
BERGETHON, ODVARD M., Hanover, N. H.
BODINSON, FREDERICK WILLIAM, Millbrae, Calif. (Rt & T)
BROWN, ROBINSON WATSON, San Antonio, Texas
CAMERON, RAYMOND ALBERT, Chicago, Ill.
CHADWICK, JOHN WILLIAM, Casper, Wyo. (Rt)
CHAPMAN, ARTHUR HORSLEY, Adelaide, South Australia (Rt)
CLOSE, SAMUEL, Cleveland, Ohio
COCHRAN, ETHELBERT W., Dayton, Ohio
CROSET, LOUIS PAUL, Colchester, England
CRUSEL, CORNELIUS, New Orleans, La.
CURTIS, ALFRED BRUNDAGE, Cleveland, Ohio
DATO, EDWIN EDWARD, Chicago, Ill.
DODSON, CHARLES WESLEY, Harrisburg, Pa.
DRYSDALE, GEORGE S., San Francisco, Calif.
DUBOIS, T. RANDALL, St. Louis, Mo.
EKLUND, WALTER BIZET, North Brookfield, Mass.
ERLACHER, A. JOHN, Philadelphia, Pa.
FELGAR, ROBERT PATTISON, JR., Austin, Texas
FELLER, ALFRED MARTIN, Syracuse, N. Y.

(*ASME News continued on page 724*)

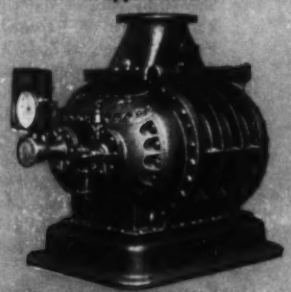
The Solvay soda process was commercially perfected in 1864. Ten years earlier, the first "Roots" Blower was produced. We're not good because we're old . . . but old because we're good.

MOVING! MIXING! MEASURING!

We give Chemicals a ride



From our standard sizes of Centrifugal and Rotary Positive Blowers, capacities are available from 5 CFM up, for separate or built-in application.



Rotary Positive Meters measure gases with cash-register accuracy, from 1,000 CFH to 1,000,000 CFH.

Most industries can profit from the experience of chemical processors in the use of Roots-Connersville equipment. Air, gas and solid particles are pushed or pulled through pipes by R-C Blowers and Vacuum Pumps. Mixtures are agitated and aerated. R-C Meters accurately measure gas input and output. Our Liquid Pumps move viscous liquids efficiently and economically.

For blowers, especially, we offer you an exclusive, important advantage. That is, our *dual-ability* to supply either Centrifugal or Rotary Positive units. Because we build both, we can recommend, without bias, the type which will do the job best. Only Roots-Connersville makes available this *dual choice.*

Our wide experience in the application of blowers and similar equipment is at your service. We help many industries to improve processes and products and to reduce costs. Consult us, without obligation.

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